FILE 'INPADOC, WPIX, TULSA, JA[redacted]O, HCAPLUS' ENTERED AT 13:42:23 ON 26 [redacted]R 2003
E JP2000-0027652/PRN,AP
L1 8 S (JP2000-27652/PRN OR JP2000-27652/AP)
L2 0 S "S05-D02B1"

FILE 'WPIX, JAPIO, TULSA' ENTERED AT 14:00:52 ON 26 MAR 2003
L3 2077 S "S05-D02B1"/MC
L4 1522 S G01R033-48/IC
L5 2896 S G01V003-00/IC
L6 0 S A61B005-055/IC/IC
L7 9879 S A61B005-055/IC
L8 172498 S (FAN OR BLOWER OR VANE OR BLADE## OR
L9 25 S L8 AND ((L3 OR L4 OR L5 OR L6) OR L7)

FILE 'MEDLINE, EMBASE, BIOSIS, COMPENDEX, INSPEC' ENTERED AT 14:08:06 ON 26 MAR 2003
L10 13 S (MRI OR MR IMAG#### OR RESONANCE IMAG###)
AND (FAN OR BLOWER OR VANE OR BLADE## OR (FLUID OR WATER OR
HYDRAULIC)(2A) MOTOR#####) AND (AIR OR VENTILAT######)
L11 7 DUP REM L10 (6 DUPLICATES REMOVED)

FILE 'PROMT' ENTERED AT 14:11:45 ON 26 MAR 2003
L12 52 S (MRI OR MR IMAG#### OR RESONANCE IMAG###)
AND (FAN OR BLOWER OR VANE OR BLADE## OR (FLUID OR WATER OR
HYDRAULIC)(2A)MOTOR#####) AND (AIR OR VENTILAT######)
L13 1715 S (MRI OR IMAG###)(8A)(AIR OR VENTILAT######)

L14 10 S L12 AND L13
D BIB KWIC 1-10

FILE 'PCTFULL, EUROPATFULL' ENTERED AT 14:14:16 ON 26 MAR 2003
L15 6006 S (MRI OR IMAG###)(8A)(AIR OR VENTILAT######)

L16 22 S (MRI OR MR IMAG#### OR RESONANCE IMAG###)/T
I,AB,CLM AND (FAN/TI,AB,CLM OR BLOWER/TI,AB,CLM OR VANE/TI,AB,C
LM OR BLADE##/TI,AB,CLM OR (FLUID OR WATER OR HYDRAULIC)(2A)
MOTOR#####/TI,AB,CLM) AND (AIR OR VENTILAT######)/TI,AB,CLM
L17 6 S L15 AND L16
D BIB KWIC 1-6

FILE 'STNGUIDE' ENTERED AT 14:17:30 ON 26 MAR 2003

FILE 'PCTFULL' ENTERED AT 14:23:27 ON 26 MAR 2003
D L17 6 CLMEN

FILE 'STNGUIDE' ENTERED AT 14:23:30 ON 26 MAR 2003

FILE 'STNGUIDE' ENTERED AT 14:23:51 ON 26 MAR 2003

FILE 'PCTFULL' ENTERED AT 14:25:00 ON 26 MAR 2003
D L17 6 AB

FILE 'STNGUIDE' ENTERED AT 14:25:01 ON 26 MAR 2003

FILE 'PCTFULL' ENTERED AT 14:25:19 ON 26 MAR 2003
D L17 6 BIB AB

FILE 'STNGUIDE' ENTERED AT 14:25:20 ON 26 MAR 2003

FILE 'MEDLINE' ENTERED AT 14:26:39 ON 26 MAR 2003
E MAGNETIC RESONANCE IMAGING/CT
E E3+ALL/CT
L18 116080 S ("MAGNETIC RESONANCE IMAGING"/CT OR
E1.370.350.500./CT OR E1.370.350.825.500./CT) OR ("DIFFUSION
MAGNETIC RESONANCE IMAGING"/CT OR "ECHO-PLANAR IMAGING"/CT OR
"MAGNETIC RESONANCE ANGIOGRAPHY"/CT OR "MAGNETIC RESONANCE
IMAGING, CINE"/CT) OR MRI
L19 504 S L18 AND (FAN OR BLOWER OR VENTILAT######
OR (ROTAT#### OR ROTOR OR ROTARY)(2A)(BLADE## OR VANE##))

L20 95 S (HYDRAULIC OR WATER OR FLUID)(2A)MOTOR#####
#

L21 0 S L19 AND L20

L22 16 S L19 AND MOTOR######

D ALL TOT

Tiffany,
Search Report
Similar to what
you have
JH

```
     FILE 'WPIX' ENTERED AT 14:49:03 ON 26 MAR 2003
L23            1 SEA ABB=ON  PLU=ON  US3983715/PN
L24            1 SEA ABB=ON  PLU=ON  DE3528821/PN
                 D MAX
                 D L23 MAX

     FILE 'DPCI' ENTERED AT 14:49:54 ON 26 MAR 2003
L25           11 SEA ABB=ON  PLU=ON  US3983715/PN.D
L26            3 SEA ABB=ON  PLU=ON  DE3528821/PN.D
L27           14 SEA ABB=ON  PLU=ON  (L25 OR L26)
                 SEL PRN

     FILE 'WPIX, JAPIO, TULSA' ENTERED AT 14:50:27 ON 26 MAR 2003
L28           18 SEA ABB=ON  PLU=ON  (DE1995-19524670/PRN OR DE1995-19538899/PRN
                  OR DE1996-19637926/PRN OR DE1996-29621697/PRN OR FR1993-4848/P
                 RN OR JP1987-58003U/PRN OR JP1989-123834U/PRN OR JP1990-16102U/
                 PRN OR JP1991-94356U/PRN OR JP1991-94394U/PRN OR JP1996-160701/
                 PRN OR JP1996-160703/PRN OR US1976-719200/PRN OR US1976-747704/
                 PRN OR US1976-749361/PRN OR US1977-837054/PRN OR US1978-872040/
                 PRN OR US1998-72349P/PRN OR US1999-235074/PRN)
                 D TI 1-18
                 D 16 ALL

     FILE 'STNGUIDE' ENTERED AT 14:51:36 ON 26 MAR 2003

     FILE 'DPCI' ENTERED AT 14:52:03 ON 26 MAR 2003
                 SEL L27 PN.G
L29          524 SEA ABB=ON  PLU=ON  (EP214553/PN.G OR EP696522/PN.G OR
                 US4748825/PN.G OR US4885916/PN.G OR US5220808/PN.G OR EP200899/
                 PN.G OR EP257569/PN.G OR EP327374/PN.G OR EP42597/PN.G OR
                 EP438076/PN.G OR EP517081/PN.G OR EP543606/PN.G OR FR2699456/PN
                 .G OR US4592207/PN.G OR US4641502/PN.G OR US4672818/PN.G OR
                 US4926655/PN.G OR US5531264/PN.G OR US5562411/PN.G OR US5582236
                 /PN.G OR US5605055/PN.G OR US5632330/PN.G OR US6223807/PN.G OR
                 DE10062686/PN.G OR DE19538899/PN.G OR DE19541934/PN.G OR
                 DE19728814/PN.G OR DE19804636/PN.G OR DE19827096/PN.G OR
                 DE20012939/PN.G OR DE4335342/PN.G OR EP169040/PN.G OR EP542577/
                 PN.G OR US4144719/PN.G OR US4201064/PN.G OR US4344356/PN.G OR
                 US4467706/PN.G OR US4607497/PN.G OR US4608834/PN.G OR US4612975
                 /PN.G OR US4622831/PN.G OR US4674294/PN.G OR US4727728/PN.G OR
                 US4732229/PN.G OR US4787210/PN.G OR US4888959/PN.G OR US4893703
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                 US4982583/PN.G OR US4987986/PN.G OR US5066067/PN.G OR US5069818
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                 /PN.G OR US5533333/PN.G OR US5613404/PN.G OR US5617732/PN.G OR
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                 /PN.G OR US5886330/PN.G OR US5911624/PN.G OR US5915344/PN.G OR
                 US5950439/PN.G OR US6041849/PN.G OR US6044656/PN.G OR US6058903
                 /PN.G OR US6092384/PN.G OR US6105383/PN.G OR US6129140/PN.G OR
                 US6142110/PN.G OR US6142865/PN.G OR US6213865/PN.G OR US6220521
                 /PN.G OR US6261173/PN.G OR US6273034/PN.G OR US6296181/PN.G OR
                 US6339934/PN.G OR US6349882/PN.G)
L30            0 SEA ABB=ON  PLU=ON  L29 AND ((L4 OR L5) OR L7 OR MRI OR
                 IMAG#####)
L31            0 SEA ABB=ON  PLU=ON  L29 AND MAGNETIC RESONANCE
L32            4 SEA ABB=ON  PLU=ON  L29 AND (A61B OR G01V OR G01R)/IC
                 D TI 1-4
L33            0 SEA ABB=ON  PLU=ON  L29 AND IMAG#####
L34            0 SEA ABB=ON  PLU=ON  L29 AND DIAGNOS#######
                 SEL L32 PRN

     FILE 'WPIX, JAPIO, TULSA' ENTERED AT 14:54:41 ON 26 MAR 2003
L35            6 SEA ABB=ON  PLU=ON  (GB1978-36450/PRN OR GB1979-31291/PRN OR
                 IT1983-22097/PRN OR JP1995-278088/PRN OR US1978-900444/PRN)
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PA Search Rept.

L23 ANSWER 1 OF 1 WPIX (C) 2003 THOMSON DERWENT
AN 1976-K2483X [42] WPIX
TI Mobile equipment air-conditioner - has pair of fans and compressor driven by hydraulic motor.
DC Q12 Q74 Q75
PA (HAIR-I) HAIR J E
CYC 6

PI	US 3983715	A	19761005	(197642)*	<--
	BR 7600743	A	19760831	(197644)	
	ZA 7600139	A	19761101	(197704)	
	CA 1030761	A	19780509	(197821)	
	GB 1525171	A	19780920	(197838)	
	IL 48875	A	19780929	(197845)	

PRAI US 1974-436088 19740124; US 1975-547969 19750207
IC B60H001-24; B60H003-04; F24F000-00; F25B027-00; F25B031-02
AB US 3983715 A UPAB: 19930901

The unitary air conditioner (40) is adapted for mounting upon the roof (22) of the mobile equipment (10). Motor (30) has fixed upon the respective upper and lower ends of its shaft (31) fans (41) and (42). The upper fan (41) is a blade-type fan having a diameter of approximately 14 inches diameter which at 2000 RPM will deliver adequate evaporative cooling. The lower fan (42) may be a blade-type fan but use a squirrel-cage type fan. Fans (41, 42) are directly mounted to the shaft (31) of motor (30). Fan (41) is located at the top of the vertical shaft (31) for circulating atmospheric air through a condenser coil (67). Fan (42) is located at the lower end of the shaft (31) for moving adequate filtered air through an evaporator coil (68) and into the operator's compartment.

FS GMPI

In Search Report

L24 ANSWER 1 OF 1 WPIX (C) 2003 THOMSON DERWENT
AN 1987-044310 [07] WPIX
DNN N1987-033901
TI Hydrostatic drive for engine fan - has biassing valve for control pressure reduction, whose spring retaining chamber is relieved towards low pressure side of circuit.
DC Q51
IN ANTON, E
PA (BOSC) BOSCH GMBH ROBERT
CYC 1
PI DE 3528821 A 19870212 (198707)* 4p <--
ADT DE 3528821 A DE 1985-3528821 19850810
PRAI DE 1985-3528821 19850810
IC F01P007-04
AB DE 3528821 A UPAB: 19930922
A fixed rate pump (11) and a hydraulic motor (13) are used in the hydrostatic drive. The speed of the fan is controlled by an adjustable pressure controller (16) which operates a by-pass. A braking valve (20) is mounted in the supply line of the motor, where valve body (21) is pressed against a seat by a spring (22).

The space, in which the valve is mounted, is connected to the return line from the motor. The spring retaining chamber (25) of the valve is relieved towards the low pressure side (15) of the open circuit.

ADVANTAGE - Power losses are kept at a min., even when blower is stationary, as well as in operation.

1/2
FS GMPI
FA AB

L23 ANSWER 1 OF 1 WPIX (C) 2003 THOMSON DERWENT
AN 1976-K2483X [42] WPIX
TI Mobile equipment air-conditioner - has pair of fans and compressor driven by hydraulic motor.
DC Q12 Q74 Q75
PA (HAIR-I) HAIR J E
CYC 6
PI US 3983715 A 19761005 (197642)* <--
BR 7600743 A 19760831 (197644)
ZA 7600139 A 19761101 (197704)
CA 1030761 A 19780509 (197821)
GB 1525171 A 19780920 (197838)
IL 48875 A 19780929 (197845)
PRAI US 1974-436088 19740124; US 1975-547969 19750207
IC B60H001-24; B60H003-04; F24F000-00; F25B027-00; F25B031-02
AB US 3983715 A UPAB: 19930901
The unitary air conditioner (40) is adapted for mounting upon the roof (22) of the mobile equipment (10). Motor (30) has fixed upon the respective upper and lower ends of its shaft (31) fans (41) and (42). The upper fan (41) is a blade-type fan having a diameter of approximately 14 inches diameter which at 2000 RPM will deliver adequate evaporative cooling. The lower fan (42) may be a blade-type fan but use a squirrel-cage type fan. Fans (41, 42) are directly mounted to the shaft (31) of motor (30). Fan (41) is located at the top of the vertical shaft (31) for circulating atmospheric air through a condenser coil (67). Fan (42) is located at the lower end of the shaft (31) for moving adequate filtered air through an evaporator coil (68) and into the operator's compartment.
FS GMPI

L17 ANSWER 6 OF 6 PCTFULL

AN 1992009919 PCTFULL ED 20020513

TIEN APPARATUS FOR RECORDING, STORING AND ELECTRONICALLY ACCESSING IMAGES

TIFR DISPOSITIF D'ENREGISTREMENT, DE MEMORISATION ET D'ACCES ELECTRONIQUE POUR DES IMAGES

IN RAMSAY, Eugene, B.;
RAMSAY, Thomas, E.;
SWENDSEN, James, E.

PA RAMSAY, Eugene, B.;
RAMSAY, Thomas, E.;
SWENDSEN, James, E.

LA English

DT Patent

PI WO 9209919 A1 19920611

DS W: AT AU BE CA CH DE DK ES FR GB GR IT JP LU NL SE

AI WO 1991-US8690 A 19911120

PRAI US 1990-616,416 19901121

ABEN Optical apparatus incorporating a lighting source (105, 208) capable of providing a substantial equal irradiance at each point of an image plane (124, 226) for use in backlighting transparencies during their reproduction and recordation. There is also disclosed and claimed apparatus (200) using the lighting source (208) to produce for the first time high quality electronic images in an analogue format of medical imagery originally or subsequently produced in a tangible form such as X-ray, CT, or **MR images**. There is further disclosed an integrated system providing apparatus for converting, storing, and retrieving images originally produced in tangible or intangible form that are subsequently converted to an analogue electronic format and stored in analogue format on an optical disc in an optical disc library. The system includes the apparatus for converting the tangible images into high quality electronic images and for converting digital images produced during CT or **MR imaging** or the like into a common analogue medium.

L17 ANSWER 6 OF 6 PCTFULL
AN 1992009919 PCTFULL ED 20020513
TIEN APPARATUS FOR RECORDING, STORING AND ELECTRONICALLY ACCESSING IMAGES
TIFR DISPOSITIF D'ENREGISTREMENT, DE MEMORISATION ET D'ACCES ELECTRONIQUE POUR DES IMAGES
IN RAMSAY, Eugene, B.;
RAMSAY, Thomas, E.;
SWENDSEN, James, E.
PA RAMSAY, Eugene, B.;
RAMSAY, Thomas, E.;
SWENDSEN, James, E.
LA English
DT Patent
PI WO 9209919 A1 19920611
DS W: AT AU BE CA CH DE DK ES FR GB GR IT JP LU NL SE
AI WO 1991-US8690 A 19911120
PRAI US 1990-616,416 19901121
ABEN . . . in an
analogue format of medical imagery originally or subsequently produced
in a tangible form such as
X-ray, CT, or **MR images**. There is further disclosed
an integrated system providing apparatus for
converting, storing, and retrieving images originally produced in
tangible or. . . apparatus for converting the
tangible images into high quality electronic images and for converting
digital images produced
during CT or **MR imaging** or the like into a common
analogue medium.
CLMEN. . . or 2, a high fidelity reproduction
of an image originally in a tangible form, such as a
medical X-ray,, computer tomography image, magnetic
resonance image or the like, can be made. Apparatus
for accomplishing this is shown in Figure 3.
Figure 3 illustrates an automated image
conversion apparatus. . . 242L and 242R closer to diffuser 248
aids in eliminating the illumination disparity that WO 92/09919
PCT/US91/08690
18
substantially no heat production, a **fan** 251 may be
used, if desired, to circulate **air** to ensure that the
interior of cabinet 202 remains at approximately room
temperature.
Lightbox 209 is spaced from lens holder 206 such
that second. . .

. . . .
When cups 372 are lowered onto a
transparency and the vacuum applied, the transparency
will be held in place by the differential **air** pressure
in a well known manner, When so held, the
transparency will be movable by the film pickup from
input bin 214 onto. . .

. . . .
to an individual one of said image
originals, said selective application means
selectively applies a vacuum to said cups to
adhere said individual **image** original to
said cups by a differential **air** pressure,
and said first carriage and said second
carriage center an area of interest of said
individual image original on said optical
areas by. . .

L9 ANSWER 2 OF 25 WPIX (C) 2003 THOMSON DERWENT
AN 2000-404489 [35] WPIX
DNN N2000-303038
TI Power supply for magnetic resonance imaging apparatus, reverses wind direction from **air** cooling **fan**, when difference of detected output value is more than predetermined value.
DC P31 S01 S05
PA (HITR) HITACHI MEDICAL CORP
CYC 1
PI JP 2000139873 A 20000523 (200035)* 6p A61B005-055 <--
ADT JP 2000139873 A JP 1998-336498 19981112
PRAI JP 1998-336498 19981112
IC ICM **A61B005-055**
ICS G01R033-28; G01R033-38
AB JP2000139873 A UPAB: 20000725
NOVELTY - A switching power supply comprises several power semiconductor switches which are attached in a heat sink which releases heat. The heat sink and switches are cooled by a **air** cooling **fan**. The temperature of the sink is detected in two different places with arbitrary heat sink. When the difference of detected output value is more than preset value, the wind direction from **air** cooling **fan** is reversed.
USE - For magnetic field generation coils such as magnetic resonance imaging apparatus.
ADVANTAGE - Eliminates non-uniformity of heat of heat sink even when heat sink is large size.
DESCRIPTION OF DRAWING(S) - The figure shows explanatory drawing of power supply for MRI.
Dwg.3/6
FS EPI GMPI
FA AB; GI
MC EPI: S01-H05; S05-D02B

L9 ANSWER 3 OF 25 WPIX (C) 2003 THOMSON DERWENT
AN 1999-501544 [42] WPIX
DNN N1999-374696
TI Magnetic disc unit assembly of MRI apparatus - includes three **air** cooling **fans** which are arranged on periphery of magnetic disc unit along three mutually perpendicular axes.
DC P31 S01
PA (SHMA) SHIMADZU CORP
CYC 1
PI JP 11216123 A 19990810 (199942)* 4p A61B005-055 <--
ADT JP 11216123 A JP 1998-24096 19980205
PRAI JP 1998-24096 19980205
IC ICM **A61B005-055**
ICS G01R033-32
AB JP 11216123 A UPAB: 19991014
NOVELTY - A magnetic disc unit (21) is arranged horizontally and three **air** cooling **fans** (22-24) are arranged on the periphery of magnetic disc unit along the three mutually perpendicular axes (X,Y,Z), such that the revolving shafts (25- 27) of three **fans** crosses orthogonally. The notation of **fans** makes the magnetic disc unit to oscillate.
USE - For MRI apparatus used for morphological diagnosis and to obtain biochemical function information on medical field.
ADVANTAGE - Provides earthquake resistant magnetic disc assembly, thus improves reliability. Enables continuous operation, thus patient's information is protected even during disaster occurrence. DESCRIPTION OF DRAWING(S) - The figure shows the MRI apparatus. (21) Magnetic disc unit; (22-24) **Air** cooling **fans**; (25-27) Revolving shafts; (X,Y,Z) Mutually perpendicular axes.
Dwg.1/2
FS EPI GMPI
FA AB; GI
MC EPI: S01-E02A

L9 ANSWER 4 OF 25 WPIX (C) 2003 THOMSON DERWENT
AN 1999-258000 [22] WPIX
DNN N1999-192295

TI Gradient magnetic field coil temperature monitor control apparatus for nuclear magnetic resonance imaging system - measures light radiating from coils, and monitors temperature rise in coils continuously.
DC P31 S01 S03
PA (SHMA) SHIMADZU CORP
CYC 1
PI JP 11076195 A 19990323 (199922)* 3p A61B005-055 <--
ADT JP 11076195 A JP 1997-247968 19970912
PRAI JP 1997-247968 19970912
IC ICM **A61B005-055**
ICS G01R033-389
AB JP 11076195 A UPAB: 19990609
NOVELTY - A power supply provides a predetermined current to a gradient magnetic field coils (52). A radiation thermometer (2) measures the temperature of the coils. Light radiated from the coils is measured, and the temperature rise in the coils is monitored continuously. The coils are cooled using an **air blower** (4). The measured temperature of the coils is stored in a memory.
USE - For nuclear magnetic resonance imaging system.
ADVANTAGE - Enables continuous measurement of temperature of coils. Improves efficiency of cooling. Reduces power consumption during cooling. Enables measurement of temperature with high precision. DESCRIPTION OF DRAWING(S) - The drawing shows the block diagram of the nuclear magnetic resonance imaging device. (2) Radiation thermometer; (52) Gradient magnetic field coils.
Dwg.2/2
FS EPI GMPI
FA AB; GI
MC EPI: S01-E02A2; S01-E02A8X; S01-H05; S03-A03; S03-B01E9; S03-E07A

L9 ANSWER 5 OF 25 WPIX (C) 2003 THOMSON DERWENT
AN 1997-113068 [11] WPIX
DNN N1997-093508
TI Coil mechanism used in MRI appts - discharges **air** from spaces provided between sound insulation members of HF coil unit, through **air blower** connected to unit.
DC P31 S01 S03 S05
PA (YOKM) YOKOGAWA MEDICAL SYSTEMS LTD
CYC 1
PI JP 09000510 A 19970107 (199711)* 5p A61B005-055 <--
ADT JP 09000510 A JP 1995-157482 19950623
PRAI JP 1995-157482 19950623
IC ICM **A61B005-055**
ICS G01R033-385
AB JP 09000510 A UPAB: 19970313
The coil mechanism comprises a static magnetic field generator (1). A coil (2) for generating magnetic field is arranged at the inner space of the magnetic field generator. A HF coil unit (3) is provided at the inner space of the magnetic field generating coil. This unit comprises a tube type winding frame (31) whose ends are equipped with support part (32). A sound insulation member (33) in the unit attached to these support parts, surrounds the contact surface of the HF coil.
The insulation member also serves as partitions for multiple spaces (34). An **air blower** (5) serving as a cooling system is used. The **air blower** establishes contact with the HF coil. **Air** from spaces between the sound insulation member is discharged through the **air blower**, thereby leading to cooling effect.
ADVANTAGE - Performs sound insulation effectively.
Dwg.1/7
FS EPI GMPI
FA AB; GI
MC EPI: S01-E02A2; S03-E07A; **S05-D02B1**

L9 ANSWER 6 OF 25 WPIX (C) 2003 THOMSON DERWENT
AN 1996-245990 [25] WPIX
DNN N1996-206615
TI Magnetic resonance dislocation picture taking device for **air** cooling device - has **air** cooling device to change suction power of suction device into arbitrary value based on detected temperature of

heat emission coil.
DC P31 S01 S03 S05 V04
PA (SHMA) SHIMADZU CORP
CYC 1
PI JP 08098829 A 19960416 (199625)* 5p A61B005-055 <--
ADT JP 08098829 A JP 1994-261965 19940930
PRAI JP 1994-261965 19940930
IC ICM **A61B005-055**
ICS G01R033-20; G01R033-385
AB JP 08098829 A UPAB: 19960625
The device includes a **ventilation fan** (21). During imaging the impedance of the magnetic field coils are detected by an impedance detector (36) at predetermined sampling time. The voltage and current are also detected and monitored by respective detection and monitoring devices (32,33,34,35).
The above referred detected values are fed to the controller (37). The optimum drive for the suction **fan** (22) and **ventilation fan** are decided by the controller.
ADVANTAGE - Prevents damage to device due to heat generated by heat emitting coil. Improves imaging environment.
Dwg.4/4
FS EPI GMPI
FA AB; GI
MC EPI: S01-E02A; S01-H05; S01-J02; S03-E07A; **S05-D02B1**; V04-T03B

L9 ANSWER 7 OF 25 WPIX (C) 2003 THOMSON DERWENT
AN 1996-245989 [25] WPIX
DNN N1996-206614
TI Magnetic resonance dislocation picture taking device for medical diagnostic imaging - has **air** cooling control device to change suction of suction device into arbitrary quantity of suction based on inspection sequence.
DC P31 S01 S03 S05 V04
PA (SHMA) SHIMADZU CORP
CYC 1
PI JP 08098828 A 19960416 (199625)* 6p A61B005-055 <--
ADT JP 08098828 A JP 1994-261964 19940930
PRAI JP 1994-261964 19940930
IC ICM **A61B005-055**
ICS **G01R033-48**
AB JP 08098828 A UPAB: 19960625
The magnetic resonance dislocation picture taking device includes a power supply (30). Two **fans** (21,22) are provided, one for suction and one for **ventilation**. The ON/OFF control of the power supply to these **fans** is performed independently by a pair of electromagnetic relays (31,32).
The person to be examined is introduced in the opening part of the gantry which is arranged at predetermined location. The suction **fan** attracts the gas from the circumference of the heat emission coil.
ADVANTAGE - Reduces unpleasant feeling to examined person.
Dwg.2/5
FS EPI GMPI
FA AB; GI
MC EPI: S01-E02A; S01-H05; S01-J02; S03-E07A; **S05-D02B1**; V04-T03B

L9 ANSWER 8 OF 25 WPIX (C) 2003 THOMSON DERWENT
AN 1996-216240 [22] WPIX
DNN N1996-181629
TI Coil cooling structure for magnetic resonance device - has **air blower** connected to second hole formed by cylinder surface of body coil for sending **air** into cover.
DC P31 S01 S05 V02
PA (YOKM) YOKOGAWA MEDICAL SYSTEMS LTD
CYC 1
PI JP 08080289 A 19960326 (199622)* 5p A61B005-055 <--
ADT JP 08080289 A JP 1994-217079 19940912
PRAI JP 1994-217079 19940912
IC ICM **A61B005-055**
ICS G01R033-20; G01R033-32

AB JP 08080289 A UPAB: 19960610
The structure includes a cylindrical body coil (21) mounted inside a cylindrical slope coil (20). A first hole cover (22) hides a through space at the outer cylinder surface of the body coil.
A second hole formed by the cylinder surface of the body coil is connected to an **air blower** which sends **air** into the cover.
ADVANTAGE - Provides efficient cooling of body coil and slope coil because of **air blower**. Improves mounting nature of body coil by protecting electric component in it with cover. Eases assembly by having cover which serves as division.
Dwg.1/6
FS EPI GMPI
FA AB; GI
MC EPI: S01-E02; S01-J02; **S05-D02B1**; V02-G02A1

L9 ANSWER 9 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 2002-224079 JAPIO
TI NOISE INTERFERENCE CONTROL DEVICE AND MRI DEVICE USING THIS DEVICE AND NOISE INTERFERENCE CONTROL METHOD
IN TSUCHIYA TOMOTOSHI
PA GE MEDICAL SYSTEMS GLOBAL TECHNOLOGY CO LLC
PI JP 2002224079 A 20020813 Heisei
AI JP 2001-10229 (JP2001010229 Heisei) 20010118
PRAI JP 2001-10229 20010118
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 2002
IC ICM **A61B005-055**
ICS G01R033-28
AB PROBLEM TO BE SOLVED: To eliminate influence imparted to an MRI image by noise of switching power source with the simple constitution.
SOLUTION: This noise interference control device prevents interference with the MRI image by a noise frequency of the switching power source 13 generated in a resonance frequency band used by an MRI device of a power source supply object, and has a detecting coil 30 and a noise monitor circuit 31 for detecting the noise frequency generated in the resonance frequency band, a variable **air** capacity **fan** 12 and a power source 11 for the **fan** for controlling a temperature of the switching power source 13, and a control device 32 for eliminating the noise frequency from the resonance frequency band by controlling the temperature of the switching power source 13 by changing a rotating speed of the variable **air** capacity **fan** 12 when the noise frequency detected by the noise monitor circuit 31 exists in the resonance frequency band of the MRI device.
COPYRIGHT: (C)2002,JPO

L9 ANSWER 10 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 2000-346922 JAPIO
TI MR APPARATUS AND METHOD OF CONTROLLING COOLING DEVICE FOR SUPERCONDUCTING MAGNET OF MR APPARATUS
IN SATO KAZUHIKO
PA GE YOKOGAWA MEDICAL SYSTEMS LTD
PI JP 2000346922 A 20001215 Heisei
AI JP 1999-156108 (JP11156108 Heisei) 19990603
PRAI JP 1999-156108 19990603
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 2000
IC ICM G01R033-3815
ICS **A61B005-055**; F25B009-00; H01F006-04; H01F006-00
AB PROBLEM TO BE SOLVED: To obtain an MR apparatus whose reliability is high and to obtain a control method for a cooling device for a superconducting magnet in an MR apparatus.
SOLUTION: An **air**-cooled compression apparatus 7 for a cooling device 4 which cools liquid helium (a coolant) 8 for a superconducting magnet 5 is installed outdoors. Either the stop of the **fan** 11 of the **air**-cooled compression apparatus 7 or the reverse of the **fan** 11 is performed either perioctically or when the cooling efficiency of the cooling device 4 is lowered. Thereby, it is not required to install a cooling facility which is used to cool heat radiated from the

cooling device 4, and an MR apparatus which is low-cost and space- saving can be realized.

L9 ANSWER 11 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1999-299757 JAPIO
TI CABINET
IN NOSE KATSUMASA; KONO KAZUHIRO
PA GE YOKOGAWA MEDICAL SYSTEMS LTD
PI JP 11299757 A 19991102 Heisei
AI JP 1998-145018 (JP10145018 Heisei) 19980417
PRAI JP 1998-145018 19980417
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1999
IC ICM **A61B005-055**
ICS H05K005-02
AB PROBLEM TO BE SOLVED: To suppress a noise leak-out caused by wind sound of a **fan** by attaching a sound absorption panel via a spacer means onto the outer face equipped with an exhaust port of a cooling **fan** of a cabinet which has a built-in gradient magnetic field amplifier, etc., for a nuclear magnetic resonance image diagnostic equipment, etc.
SOLUTION: This cabinet 30 has an exothermic unit 12 to generate heat inside, and a cooling **fan** 14 is equipped on the back side inside the cabinet 30 to prevent overheat of the cabinet 30 by heat radiated by the exothermic unit 12. A support 32 is erected as a spacer means on the back side equipped with the exhaust port of the cooling **fan** 14 and a sound absorption panel 34 is attached on the tip end part of the support 32. Thus a space is secured between the exhaust port and the sound absorption panel 34 enable the exhaust **air** from the exhaust **air** to be exhausted outside. A noise caused by the wind sound of the cooling **fan** 34 is attenuated by the sound absorption performance of the sound absorption panel 43 for reducing noise.

L9 ANSWER 12 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1999-216123 JAPIO
TI MAGNETIC RESONANCE IMAGING DEVICE
IN MIURA YOSHIAKI
PA SHIMADZU CORP
PI JP 11216123 A 19990810 Heisei
AI JP 1998-24096 (JP10024096 Heisei) 19980205
PRAI JP 1998-24096 19980205
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1999
IC ICM **A61B005-055**
ICS G01R033-32
AB PROBLEM TO BE SOLVED: To provide a magnetic resonance imaging device having an earthquake proof magnetic disk that runs with no trouble to a place much in vibration or a large vibration.
SOLUTION: The imaging device is provided with a magnetic disc device which is set in a data processing part of a host computer. The magnetic disc device 21 is set horizontally and on the periphery of it, **air** -cooling **fan** 22, 23, 24 are set in three axis direction (X, Y, Z) as each rotation axis orthogonally and integrated into the magnetic disc device 21. It is at running state at all time and by the rotation of the **air**-cooling **fan** 22, 23, 24, force is worked to the direction that controls a vibration or swinging of the magnetic disc device 21 based on the gyroscope principal.

L9 ANSWER 13 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1999-076195 JAPIO
TI MAGNETIC RESONNACE IMAGING
IN FUJITA AKINORI
PA SHIMADZU CORP
PI JP 11076195 A 19990323 Heisei
AI JP 1997-247968 (JP09247968 Heisei) 19970912
PRAI JP 1997-247968 19970912
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1999
IC ICM **A61B005-055**
ICS G01R033-389
AB PROBLEM TO BE SOLVED: To continuously and accurately measure a temperature

even at image pickup time without imparting a noise to a magnetic resonance image by introducing infrared rays generated from an inclined magnetic field coil to the outside by an infrared fiber, and measuring the temperature by a radiation thermometer.
SOLUTION: Cooling **air** is sent into a **ventilating** duct 55 by a cooling **air blower** 4 arranged outside a device, and an inclined magnetic field coil 52 is cooled by flowing the **air** in the arrow direction. An infrared fiber 1 is set in this inclined magnetic field coil 42, and a temperature can be continuously measured even at image pickup time by introducing infrared rays radiated from the inclined magnetic field coil 52 to a radiation thermometer 2 by this infrared fiber 1. The temperature measured by the radiation thermometer 2 is read in a control computer 3, and a control signal to set necessary **air** blowing quantity is sent out to the cooling **air blower** 4 from here, and cooling efficiency of a heating part is enhanced, and electric power consumption not less than necessary at cooling time is restrained.

L9 ANSWER 14 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1998-225446 JAPIO
TI MAGNETIC RESONANCE INSPECTING DEVICE
IN TSUDA MUNETAKA
PA HITACHI MEDICAL CORP
PI JP 10225446 A 19980825 Heisei
AI JP 1997-44913 (JP09044913 Heisei) 19970214
PRAI JP 1997-44913 19970214
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1998
IC ICM **A61B005-055**
ICS G01R033-3815; G01R033-385
AB PROBLEM TO BE SOLVED: To provide comfortable inspecting environment for an examinee, to improve the quality of an inspecting result and to accelerate inspection by reducing noise caused by cooling as the examinee receives psychological stress by noise due to the cooling of the gradient magnetic field coil of an MRI device.
SOLUTION: Cool **air** is blown into a gap between a seam bobbin 102 and a gradient magnetic field coil bobbin 103 from a **fan** 107. The cool **air** is discharged to the outside from an exhausting duct 108 while equally moving around the outer peripheral surface of the bobbin 103. On the other hand, the computer 115 calculates a heat generating value and a heat radiating value by the gradient magnetic field coil to calculate the present temperature of the gradient magnetic field coil. A **fan** control circuit 112 is controlled by this temperature and the operating timing of the gradient magnetic field to substantially reduce noise.

L9 ANSWER 15 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1997-253083 JAPIO
TI MEDICAL EQUIPMENT
IN SAKUMA YOSHIHIRO
PA TOSHIBA CORP
PI JP 09253083 A 19970930 Heisei
AI JP 1996-72366 (JP08072366 Heisei) 19960327
PRAI JP 1996-72366 19960327
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1997
IC ICM A61B008-00
ICS **A61B005-055**; A61B006-00; A61L002-10; A61L002-20
AB PROBLEM TO BE SOLVED: To save labor and time required for sterilization and to effectively perform the sterilization by providing an ozone sterilizer for feeding ozone into the part to be sterilized in a medical equipment.
SOLUTION: An **air blower** 19 is connected through a discharge side duct 27a, three-way valve 33 and discharge side duct 27b to the outside of an ozone sterilizer 15 and connected through a discharge side duct 27c to an ozone generator 21, and **air** outside the ozone sterilizer 15 is fed into the ozone generator 21. Besides, the ozone generator 21 is connected through a discharge side duct 27d to a humidifier 23, and generated ozope is fed into the humidifier 23 together with **air** sent in by the **air blower** 19. Then,

the humidifier 23 is connected through a discharge side duct 27e to a discharge port into a space S, and the ozone fed from the ozone generator 21 is mixed into generated steam and sent from the discharge port into the space S. Further, an ozone decomposer 25 decomposes the ozone, which is mixed into the steam sent from the space S, into oxygen and discharges it.

L9 ANSWER 16 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1996-098829 JAPIO
TI MAGNETIC RESONANCE TOMOGRAPHIC SYSTEM
IN MIURA YOSHIAKI
PA SHIMADZU CORP
PI JP 08098829 A 19960416 Heisei
AI JP 1994-261965 (JP06261965 Heisei) 19940930
PRAI JP 1994-261965 19940930
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1996
IC ICM **A61B005-055**
ICS G01R033-385; G01R033-20
AB PURPOSE: To provide a magnetic resonance tomographic system capable of performing the optimum **air** cooling for heat generation when a gradient magnetic field coil, etc., is driven and performing the image pick-up of an image under the optimum inspecting environment.
CONSTITUTION: The impedance of coils 14X, 14Y and 14Z which comprise the gradient magnetic field coil in the image pickup of the image are detected by a current detector 32, a voltage detector 33, a current monitor 34, a voltage monitor 35 and an impedance monitor 36 at a prescribed sampling timing. and they are supplied to a controller 37. The controller 37 decides the driving quantity of a **fan** 21 for **air** blowing and a **fan** 22 for suction optimum for the cooling of generated heat by the driving of the gradient magnetic field coil based on supplied impedance, and drives the **fan** 21 for **air** blowing and the **fan** 22 for suction with such driving quantity.

L9 ANSWER 17 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1996-098828 JAPIO
TI MAGNETIC RESONANCE TOMOGRAPHIC SYSTEM
IN MIURA YOSHIAKI
PA SHIMADZU CORP
PI JP 08098828 A 19960416 Heisei
AI JP 1994-261964 (JP06261964 Heisei) 19940930
PRAI JP 1994-261964 19940930
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1996
IC ICM **A61B005-055**
ICS **G01R033-48**
AB PURPOSE: To provide a magnetic resonance tomographic system capable of reducing a noise when an exoergic coil in a gantry is **air**-cooled while inspection is being performed.
CONSTITUTION: The on/off operations for the supply of a power to a **fan** 21 for **air** blowing and a **fan** 22 for suction to **air**-cool a gradient magnetic field coil, etc., provided in the inside of the gantry are performed by electromagnetic relays 31, 32 independently. The **air** cooling of the gradient magnetic field coil is performed only by suction by driving only the **fan** 22 for suction for a time between the start of inspection and that of the image pickup of an image and a time between the completion of image pickup of the image and the completion of inspection, and while the image is image-picked up, the **air** cooling of the gradient magnetic field coil, etc., is performed by the **air** blowing and the suction by driving the **fan** 21 for **air** blowing and the **fan** 22 for suction.

L9 ANSWER 18 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1996-098825 JAPIO
TI MRI SYSTEM
IN MITSUMATA HIROSHI; MAEKAWA AKINOBU; INOUE HIROSHI
PA SHIMADZU CORP
PI JP 08098825 A 19960416 Heisei
AI JP 1994-238011 (JP06238011 Heisei) 19940930

PRAI JP 1994-238011 19940930
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1996
IC ICM **A61B005-055**
ICS G01R033-3815
AB PURPOSE: To exclude incongruity for an examinee by cooling a gradient coil and also cooling a gantry cover itself on which the examinee touches frequently with high efficiency.
CONSTITUTION: When cooling **air** is sent in from a **blower** duct 4, the **air** passes first between a gradient coil bobbin 3 and the gantry cover 9, and moved to the other end of the gradient coil bobbin, however, its direction is inverted without going around the rear side of a magnetostatic field magnet 1 since a shielding member 7 exists, and it returns to a shielding member 8 passing between the gradient coil 2 and the magnetostatic field magnet 1, and after that, the cooling **air** is exhausted to the outside of the device by an exhaust duct 5, which cools the cover and also the gradient coil with high efficiency.
COPYRIGHT: (C)1996,JPO

L9 ANSWER 19 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1996-080289 JAPIO
TI COOLING STRUCTURE FOR MR DEVICE COIL
IN HAYASHI YUJIRO; NOSE KATSUMASA
PA GE YOKOGAWA MEDICAL SYST LTD
PI JP 08080289 A 19960326 Heisei
AI JP 1994-217079 (JP06217079 Heisei) 19940912
PRAI JP 1994-217079 19940912
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1996
IC ICM **A61B005-055**
ICS G01R033-32; G01R033-20
AB PURPOSE: To provide a coil cooling structure capable of efficiently cooling a body coil and a gradient coil in a coil cooling structure of MR device with a cylindrical gradient coil and a cylindrical body coil constructed in the gradient coil through a space.
CONSTITUTION: This cooling structure for MR device coil is composed of a cover 22, which is installed on the outside cylinder face of a body coil 21, covering the outside cylinder face of the body coil 21 through a space and with first holes 22a bored on the face facing to the gradient coil 20, second holes 21a formed on the cylinder surface of the body coil 21 and a **blower** 23 connected to second holes 21a to send an **air** flow into the cover.
COPYRIGHT: (C)1996,JPO

L9 ANSWER 20 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1995-178071 JAPIO
TI MAGNET ASSEMBLY OF MRI SYSTEM
IN NISHIYAMA MINORU; INOUE YUJI
PA GE YOKOGAWA MEDICAL SYST LTD
PI JP 07178071 A 19950718 Heisei
AI JP 1993-327097 (JP05327097 Heisei) 19931224
PRAI JP 1993-327097 19931224
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1995
IC ICM **A61B005-055**
ICS G01R033-389; H01F007-02
AB PURPOSE: To improve the heat conductive efficiency and the control follow-up property, to make a **fan** unnecessary, and to make enclosures in a small size (thin form).
CONSTITUTION: Pillar yokes 6a and 6b are heated by heaters 8a and 8b in the direct heat transfer, and between the pillar yokes 6a and 6b, and enclosures 2a and 2b, no **air** layer is generated, but insulators 10 are filled.
COPYRIGHT: (C)1995,JPO

L9 ANSWER 21 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1993-285118 JAPIO
TI MAGNETIC RESONANCE IMAGING DEVICE
IN IIZUKA MASAHIRO; YOSHINO HITOSHI
PA HITACHI MEDICAL CORP
PI JP 05285118 A 19931102 Heisei
AI JP 1992-112305 (JP04112305 Heisei) 19920406
PRAI JP 1992-112305 19920406

SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1993
IC ICM **A61B005-055**
ICS G01R033-38
AB PURPOSE: To surely prevent variance in magnetostatic field intensity due to heat even in the case a gradient magnetic field generating means is used with a large current and high frequency by making heat generated from the gradient magnetic field generating means absorbed by a heat transfer means and the heat radiate to an external space, detecting a temperature of the gradient magnetic field generating means and controlling variably the heat transfer quantity of the heat transfer means.
CONSTITUTION: Heat generated from gradient magnetic field coils 8a, 8b is transferred to a heat absorbing part 30 of a heat pipe, transferred to a heat radiating part 31 by a theory of the heat pipe, and also, radiated to a free space through a fin 32. In this case, a temperature of the gradient magnetic field coils 8a, 8b is detected by a temperature sensor 34, and a detected temperature and a set temperature are compared by a temperature control circuit 35. In such a state, in the case the detected temperature is extremely higher than the set temperature, the **air** quantity of a heat radiation **fan** 33 is increased, and in the case the detected temperature is a little higher than the set temperature, the **air** quantity of the heat radiation **fan** 33 is decreased, and in the case the detected temperature is the same or lower as or than the set temperature, the heat radiation **fan** 33 is stopped.
COPYRIGHT: (C)1993,JPO&Japio

L9 ANSWER 22 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1992-017838 JAPIO
TI COOLING SYSTEM FOR MEDICAL DIAGNOSTIC APPARATUS
IN OGAWA YUKIHIRO
PA TOSHIBA CORP
PI JP 04017838 A 19920122 Heisei
AI JP 1990-119979 (JP02119979 Heisei) 19900511
PRAI JP 1990-119979 19900511
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1992
IC ICM **A61B005-055**
ICS A61B006-03; F24F001-00
AB PURPOSE: To cool the inside of a construction unit accurately regardless of external environment by cooling the inside of the construction unit using an external heat exchange means outside the setting of the construction unit to prevent the generation of dust and noises in a room where the construction unit is set.
CONSTITUTION: Cold **air** which is heat exchanged with a heat exchanger 4 outside a room A is sent into a heat exchanger 5 in a cooling section to cool the inside of the cooling section 3, which cools the inside of a frame base 1. Hence, there is no need for providing a cooling **fan** in the frame base 1 and as dirt such as dust generated in the cooling section 3 is discharged outside the room A through a duct 6, the flying of dirt in the room A is prevented thereby enabling the setting of the frame base 1 in a clean room such as operation room without trouble. This also prevents the generation of noises as caused by the cooling **fan**. Thus, the inside of the cooling section 3 is cooled down to a desired temperature using a temperature sensor 9 thereby enabling the cooling of the inside of the frame base 1 accurately.
COPYRIGHT: (C)1992,JPO&Japio

L9 ANSWER 23 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1990-237541 JAPIO
TI COOLING DEVICE OF MR GRADIENT COIL
IN TAKAHASHI MAKOTO
PA YOKOGAWA MEDICAL SYST LTD
PI JP 02237541 A 19900920 Heisei
AI JP 1989-59364 (JP01059364 Heisei) 19890310
PRAI JP 1989-59364 19890310
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1990
IC ICM **A61B005-055**
ICS G01R033-38
AB PURPOSE: To lower noise by constituting the title device of a hollow cylindrical tube, the first and second side plates, an **air blower** sending cooling **air** into the tube and a sucking **blower** sucking the hot **air** in the tube.

CONSTITUTION: The cooling **air** sent out from an **air blower** 14 reaches the space between an inner cylinder 3 and an outer cylinder 4 having the gradient coil 1 of a hollow cylindrical tube 2 arranged thereto through the first side duct 8 surrounding the first side plate 6 and the first side plate 6 having vent holes provided to the entire surface thereof and cools the gradient coil 1 herein. The **air** becoming hot **air** after the completion of cooling is sucked in a sucking **blower** 16 through the second side plate 7 and the second duct 9. When the **air blower** 14 and the sucking **blower** 16 are kept away from MR, the noise around an examinee is reduced and the noise due to the solid propagation of the gradient coil 1 can be prevented by the damping member 11a of a set screw 11.

L9 ANSWER 24 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1990-055043 JAPIO
TI MR IMAGING DEVICE
IN KONDO SHOJI; AOKI MICHIHIKO
PA HITACHI LTD
PI JP 02055043 A 19900223 Heisei
AI JP 1988-205764 (JP63205764 Showa) 19880819
PRAI JP 1988-205764 19880819
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1990
IC ICM **A61B005-055**
AB PURPOSE: To allow a talk with a person to be checked in a static magnetic field generation section and the **ventilation** and draft around the person to be checked by arranging an **air** voice transmitting tube with one end located at the hollow section of a superconducting magnet where the person to be checked lies and the other end located on the operator side and installing a tube **air** feeding means in the middle section.
CONSTITUTION: The voice of a person to be checked 5 is sucked by a **fan** 11 together with the **air** flowing through a tube from the receiving side tube of an **air** voice transmitting tube 9B made of a nonmagnetic and nonconducting material and arranged with an opening section near the person to be checked 5 and transmitted to an operator 21 on the other end. The **air** around the person to be checked 5 is set out for sufficient **ventilation**. The voice of the operator 21 is transmitted to the person to be checked 5 from the other end arranged near the person to be checked 5 together with the **air** flowing through the tube by a **fan** 10 via the transmitting side tube of an **air** voice transmitting tube 9A arranged with an opening section near the operator 21, the outside **air** is invariably fed in for a sufficient draft.

L9 ANSWER 25 OF 25 JAPIO COPYRIGHT 2003 JPO
AN 1989-169028 JAPIO
TI HOT-WATER WASHING TYPE CLOSET
IN TASHIRO KUSUKUMA; UENO TAKAHARU; YAMAMOTO KEISUKE
PA INAX CORP
PI JP 01169028 A 19890704 Heisei
AI JP 1987-331018 (JP62331018 Showa) 19871225
PRAI JP 1987-331018 19871225
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1989
IC ICM E03D009-08
ICS A61L009-015; **G01V003-00**
ICA G01V009-00
AB PURPOSE: To attain deodorization by installing a heater and an electrode for generating ozone to a blast circuit, blowing off ozone together with weak **air** during easing nature by a control means and blowing off ozone together with hot **air** after washing after evacuation.
CONSTITUTION: A control case 6 is placed between a low tank and a closet cover 5, and a hot-water supply section 7 to which a hot-water shower nozzle 8 is fitted, a **fan** 11 having a heater and an electrode section for generating ozone and a control operating section 9 are mounted to the case 6. Chilled **air**, hot **air** and ozone are blown off into a closet from an **air** plenum 12 for the **fan** 11. The **fan** 11 is inched and ozone is blown off

while blasting weak **air** during easing nature, an anus section, etc., are washed with hot water from the supply section 7 after evacuation, and ozone is blown off in a coupling manner together with hot **air**. Accordingly, an odor due to evacuation is deodorized, and a washing section can be sterilized simultaneously.

L17 ANSWER 2 OF 6 PCTFULL COPYRIGHT 2003 Univentio
AN 2002016957 PCTFULL ED 20020711 EW 200209
TIEN **MRI** METHOD
TIFR METHODE D'IRM
IN HAYEK, Zamir, 10 Downage, London NW4 1AA, GB [GB, GB]
PA HAYEK, Zamir, 10 Downage, London NW4 1AA, GB [GB, GB]
AG JENKINS, Peter, David, Page White & Farrer, 54 Doughty Street, London WC1N 2LS, GB
LAF English
LA English
DT Patent
PI WO 2002016957 A1 20020228
AI WO 2001-GB3820 A 20010822
PRAI GB 2000-0021087.2 20000825
TIEN **MRI** METHOD
ABEN A method of operating a magnetic **resonance imaging** scanner for imaging the heart of a patient comprising inducing apnoea in the patient; sensing an electrical heart waveform; in response thereto. . .

DETD . . . to an apparatus for artificial respiration in accordance with an embodiment of the invention;
Figure 2 shows a first embodiment of a **ventilator** for producing artificial respiration and controlling an **MRI** scanner; and
Figure 3 shows a block schematic diagram of the ventilator of Figure 2.

CLMEN 1 A method of operating a magnetic **resonance imaging** scanner for imaging the heart of a patient comprising
inducing apnoea in the patient;
sensing an electrical heart waveform;
in response thereto moving the. . .

3 A method of operating a magnetic **resonance imaging** scanner for imaging the heart of a patient comprising
inducing apnoea in the patient
sensing an electrical heart waveform
in response thereto applying pressure. . .

. . . .
The method of claim 4 wherein said step of applying cyclic pressure changes comprises selecting a desired magnitude of pressure at a **blower** and successively reversing a connection of said **blower** to said chamber to thereby successively apply a positive pressure and a negative pressure.

. . . .
6 The method of claim 5 further comprising feeding back a pressure in said chamber to control the output of said **blower**.

7 A magnetic **resonance imaging** device comprising a magnetic **resonance imaging** scanner, a structure in use engaging at least the chest of a patient to define, with said chest, a pressure chamber, a. . . of said patient, said forced respiration comprising successive inspiration and expiration periods, and plural electrodes connected to said respirator device and said magnetic **resonance imaging** scanner for sensing an electrical waveform of the heart of said patient, and triggering said magnetic **resonance imaging** scanner in accordance with said waveform, and a discriminator device for triggering said forced respiration in synchronism with a predetermined point of said. . .

8 The magnetic **resonance imaging** device of claim 7 wherein

said discriminator device is operable to determine the time period between successive maximum electrical amplitudes of said waveform, and further comprises variable timing circuitry for setting a triggering instant as a proportion of said time period.
The magnetic **resonance imaging** device of claim 7
wherein
said discriminator device is operable to provide a trigger pulse in response to a predetermined characteristic of. . .

10 The magnetic **resonance imaging** device of claim 7,
8 or 9,
wherein said respirator device comprises a **blower** in use inducing **air** at an inlet and propelling said **air**
from an
outlet, a valve having a valve member and a body, said body having a first port connected to said inlet, a second port connected to said outlet, a third exhaust port connected to the ambient **air** and a fourth port connected to said chamber and a drive motor for moving said valve member with respect to said body. . .

11 The magnetic **resonance imaging** device of claim 10
wherein
said drive motor is further operable to move said valve member to a third position is which. . .

12 The magnetic **resonance imaging** device of claim 11
wherein
said respirator device comprises control circuitry for said drive motor.

13 The magnetic **resonance imaging** device of claim 12
wherein
said control circuitry comprises said discriminator device.
. The magnetic **resonance imaging** device of claim 13
wherein
said respirator further comprises a **blower** drive motor connected to said control circuitry whereby said control circuitry is operable to set a desired output pressure from said **blower**.

15 The magnetic **resonance imaging** device of claim 14
wherein
said respirator has a pressure feedback transducer having an output connected to said control circuitry for regulating the pressure output by said **blower**.

16 The magnetic **resonance imaging** device of any of
claims
12-15 wherein said control circuitry comprises a digital processor..

17 A **ventilator** for artificial respiration comprising a **blower** having an **air** inlet and an **air**
outlet, a valve having a
valve body and a valve member, the valve body having a first port connected to said inlet, a second port connected to said outlet, a third port connected to the ambient **air** and a fourth port for connection to a structure in use defining at least in part a **ventilator** chamber, the valve member having a first position in which said first and third ports are connected together and said second and. . . second position in which said second and third
ports are connected together and said first and fourth ports are connected together, the **ventilator** further comprising a first drive motor for operating said **blower**, a second drive motor for operating said valve and control circuitry for controlling said second drive motor to move said valve member between said first and second positions, the **ventilator** yet

further comprising a connection device for electro-cardiograph leads and discrimination circuitry for determining a selected electrical event at said connection device and. . . f irst position at a predetermined time relationship to said electrical event, said discrimination circuitry having an output for connection to a magnetic **resonance imaging** device for triggering said device in accordance with a desired electrical condition at said connection device

18 The **ventilator** of claim 17 wherein said discrimination circuitry is operable to determine the time period between successive maximum electrical amplitudes of said waveform,. . .

19 The **ventilator** of claim 17 wherein said discrimination circuitry is operable to provide a trigger pulse in response to a predetermined characteristic of said. . .

20 The **ventilator** of claim 17, 18 or 19, wherein said respirator device comprises a **blower** in use inducing **air** at an inlet and propelling said **air** from an outlet, a valve having a valve member and a body, said body having a first port connected to said inlet, a second port connected to said outlet, a third exhaust port connected to the ambient **air** and a fourth port connected to said chamber and a drive motor for moving said valve member with respect to said body. . . in which said second port is connected to said fourth port and said first port is connected to said third port.
. The **ventilator** of claim 20 wherein said drive motor is further operable to move said valve member to a third position i's which 'said. . .

22 The **ventilator** of claim 21 wherein said respirator device comprises control circuitry for said drive motor.

23 The **ventilator** of claim 22 wherein said control circuitry comprises said discriminator device.

24 The **ventilator** of claim 23 wherein said respirator further comprises a **blower** drive motor connected to said control circuitry whereby said control circuitry -is operable to set a desired output pressure from said **blower**.

25 The **ventilator** of claim 24 wherein said respirator has a pressure feedback input connected to said control circuitry for regulating the pressure output by said **blower**.

26 The **ventilator** of any of claims 22-25 wherein said control circuitry comprises a digital processor.

L17 ANSWER 4 OF 6 PCTFULL

AN 2000021601 PCTFULL ED 20020515

TIEN METHOD AND APPARATUS FOR DELIVERING A MEASURED AMOUNT OF A GAS

TIFR PROCEDE ET APPAREIL D'ADMINISTRATION D'UNE QUANTITE MESUREE DE GAZ

IN ALBERT, Mitchell, S.;
VENKATESH, Arvind;
WARD, Charles, F., III

PA THE BRIGHAM AND WOMEN'S HOSPITAL, INC.

LA English

DT Patent

PI WO 2000021601 A1 20000420

DS W: AU CA JP AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE

AI WO 1999-US23323 A 19991007

PRAI US 1998-60/103,659 19981009

ABEN The present invention uses a **ventilator** (102) and a series of valves (110, 114) to deliver a special gas into a patient. The present invention finds use in the field of **MRI imaging.** Attached to the tube extending from the **ventilator** (102) to the patient is attached a first valve (110). This valve (110) alternately connects the patient to the **ventilator** (102) then to a supply of the special gas (122). Between the first valve (110) and the supply of gas. . . controls the rate at which the special gas (122) enters the patient. A computer (124) is also attached to the **ventilator** (102) and valves (110, 114) to synchronize the opening and closing of the valves (110, 114) and the operation of the **ventilator** (102) with the patient's respiratory cycles.

CLMEN I I A device for delivering a special gas to a patient, comprising:
a **ventilator** having a tube that connects the **ventilator** to the patient;
a first valve, located on the tube between the patient and the **ventilator**;
a container of the special gas, connected to the first valve, wherein the first valve alternately switches positions to connect the patient to the **ventilator**, then to connect the patient to the special gas;
a controller; and
detection equipment, connected to the controller, for signaling respiration cycles of the patient, wherein the **ventilator** and first valve are also connected to the controller, and
wherein the controller controls the position of the first valve based. . .

7 A method for delivering a special gas to a patient, comprising:
providing a **ventilator** having a tube that connects the **ventilator** to the patient;
providing a first valve, located on the tube between the patient and the **ventilator**;
providing a container of the special gas, connected to the first valve, wherein the first valve alternately switches positions to connect the patient to the **ventilator**, then to connect the patient to the container of the special gas;
sensing respiration cycles of the patient using a controller and. . .

14 The device as described in claim 13 wherein the container of the first material is one of a compressor, **ventilator**, and **fan**.

15 The device as recited in claim 13, wherein the first material is one of a gas and liquid, and the special material is one of a gas and a liquid.
COMPUTER SAR-830 SERIES **VENTILATOR**
-z- 1 02

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Freeform Search

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Term:
L12 and (plastic or ceramic or nonmetallic$4 or nonmagnetic$8 on non-metallic$4 or non-magnetical$4 or "non metallic$4" or "non magnetic$4")

Display: 100 **Documents in Display Format:** - **Starting with Number** 1

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Search History

DATE: Wednesday, March 26, 2003 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
	DB=USPT,PGPB,JPAB,EPAB,DWPI,TDBD; PLUR=YES; OP=ADJ		
L13	L12 and (plastic or ceramic or nonmetallic$4 or nonmagnetic$8 on non-metallic$4 or non-magnetical$4 or "non metallic$4" or "non magnetic$4")	6	L13
L12	L11 not l10	7	L12
L11	L7 and (flow$4 with air)	14	L11
L10	L9 and (flow$4 with air)	7	L10
L9	L8 and ((flow$4 or accross or across or mov$8) with (air))	10	L9
L8	L7 and ((provid$4 or suppl$4) with (air))	29	L8
L7	L5 and (provid$4 or suppl$4)	155	L7
L6	L5 and (provid$4)	133	L6
L5	L4 and (air)	165	L5
L4	L3 and ((adjust or chang$4 or modif$8 or alter$4 or mov$8 or shift$4 or switch$4) with (position or location) with (subject or object or patient))	813	L4
L3	L2 and (receiv$5 or transmit$8 or transceiv$4 or detect$5 or ((picked with up) with (coil or probe)))	6493	L3
L2	L1 and (magnet or (magnet$8 with means))	9823	L2
L1	((magnetic adj resonance) or MRI or NMR)	143345	L1

END OF SEARCH HISTORY

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1. Document ID: US 20020173717 A1

L9: Entry 1 of 10 File: PGPB Nov 21, 2002

PGPUB-DOCUMENT-NUMBER: 20020173717
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020173717 A1

TITLE: Apparatus for use in neonatal magnetic resonance imaging

PUBLICATION-DATE: November 21, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Rohling, Kenneth William	Burnt Hills	NY	US	
Watkins, Ronald Dean	Niskayuna	NY	US	
Dumoulin, Charles Lucian	Ballston Lake	NY	US	
Piel, Joseph Edward JR.	Scotia	NY	US	
Rossi, Charles John JR.	Amsterdam	NY	US	
Giaquinto, Randy Otto John	Burnt Hills	NY	US	

US-CL-CURRENT: 600/415

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

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2. Document ID: US 20020101959 A1

L9: Entry 2 of 10 File: PGPB Aug 1, 2002

PGPUB-DOCUMENT-NUMBER: 20020101959
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020101959 A1

TITLE: Multi-leaf collimator and medical system including accelerator

PUBLICATION-DATE: August 1, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Kato, Kohei	Hitachi		JP	
Akiyama, Hiroshi	Hitachiohta		JP	
Yanagisawa, Masaki	Hitachi		JP	

US-CL-CURRENT: 378/152; 378/65

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

3. Document ID: US 6006175 A

L9: Entry 3 of 10 File: USPT Dec 21, 1999

US-PAT-NO: 6006175
DOCUMENT-IDENTIFIER: US 6006175 A

TITLE: Methods and apparatus for non-acoustic speech characterization and recognition

DATE-ISSUED: December 21, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Holzrichter; John F.	Berkeley	CA		

US-CL-CURRENT: 704/208; 704/205, 704/206, 704/207

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Drawι Desc | Image

4. Document ID: US 5724970 A

L9: Entry 4 of 10 File: USPT Mar 10, 1998

US-PAT-NO: 5724970
DOCUMENT-IDENTIFIER: US 5724970 A

TITLE: Multipositional MRI for kinematic studies of movable joints

DATE-ISSUED: March 10, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Votruba; Jan	Elmont	NY		
Shenoy; Rajendra	Commack	NY		
Damadian; Raymond V.	Woodbury	NY		

US-CL-CURRENT: 600/415; 5/601, 5/622, 5/624, 600/410

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Drawι Desc | Image

5. Document ID: US 5497766 A

L9: Entry 5 of 10 File: USPT Mar 12, 1996

US-PAT-NO: 5497766
DOCUMENT-IDENTIFIER: US 5497766 A

TITLE: Ventilator and care cart each capable of nesting within and docking with a hospital bed base

DATE-ISSUED: March 12, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Foster; L. Dale	Brookville	IN		
Reeder; Ryan A.	Brookville	IN		

US-CL-CURRENT: 128/200.24; 128/204.18

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 6. Document ID: US 5457831 A

L9: Entry 6 of 10 File: USPT Oct 17, 1995

US-PAT-NO: 5457831
DOCUMENT-IDENTIFIER: US 5457831 A

TITLE: Ventilator, care cart and motorized transport each capable of nesting within and docking with a hospital bed base

DATE-ISSUED: October 17, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Foster; L. Dale	Brookville	IN		
Reeder; Ryan A.	Brookville	IN		

US-CL-CURRENT: 5/510; 5/503.1

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 7. Document ID: US 5337845 A

L9: Entry 7 of 10 File: USPT Aug 16, 1994

US-PAT-NO: 5337845
DOCUMENT-IDENTIFIER: US 5337845 A

TITLE: Ventilator, care cart and motorized transport each capable of nesting within and docking with a hospital bed base

DATE-ISSUED: August 16, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Foster; L. Dale	Brookville	IN		
Reeder; Ryan A.	Brookville	IN		

US-CL-CURRENT: 180/11; 180/13, 180/19.1, 180/65.1, 5/510

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

8. Document ID: US 5335651 A

L9: Entry 8 of 10 File: USPT Aug 9, 1994

US-PAT-NO: 5335651
DOCUMENT-IDENTIFIER: US 5335651 A

TITLE: Ventilator and care cart each capable of nesting within and docking with a hospital bed base

DATE-ISSUED: August 9, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Foster; L. Dale	Brookville	IN		
Reeder; Ryan A.	Brookville	IN		

US-CL-CURRENT: 128/202.13; 128/202.27, 128/897, 248/129, 296/20, 5/2.1, 5/503.1, 5/658

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

9. Document ID: US 4985678 A

L9: Entry 9 of 10 File: USPT Jan 15, 1991

US-PAT-NO: 4985678
DOCUMENT-IDENTIFIER: US 4985678 A

TITLE: Horizontal field iron core magnetic resonance scanner

DATE-ISSUED: January 15, 1991

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Gangarosa; Raymond E.	Decatur	GA		
Chui; K. Ming	Chagrin Falls	OH		

US-CL-CURRENT: 324/318; 335/296, 600/421

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

10. Document ID: US 4859948 A

L9: Entry 10 of 10 File: USPT Aug 22, 1989

US-PAT-NO: 4859948
DOCUMENT-IDENTIFIER: US 4859948 A

TITLE: Device for positioning a sample carrier in an NMR spectrometer

DATE-ISSUED: August 22, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Kuster; Anton	Greifensee			CH

US-CL-CURRENT: 324/318; 324/300

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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Term	Documents
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ACCROSSES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
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ACROSSES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	24
AIR.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2231560
AIRS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1368
FLOW$4	0
FLOW.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2246438
FLOWA.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	26
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FLOWABE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2
(L8 AND ((FLOW$4 OR ACCROSS OR ACROSS OR MOV$8) WITH (AIR))).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	10

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☐ 1. Document ID: US 20020101959 A1

L10: Entry 1 of 7 File: PGPB Aug 1, 2002

PGPUB-DOCUMENT-NUMBER: 20020101959
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020101959 A1

TITLE: Multi-leaf collimator and medical system including accelerator

PUBLICATION-DATE: August 1, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Kato, Kohei	Hitachi		JP	
Akiyama, Hiroshi	Hitachiohta		JP	
Yanagisawa, Masaki	Hitachi		JP	

US-CL-CURRENT: 378/152; 378/65

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 2. Document ID: US 6006175 A

L10: Entry 2 of 7 File: USPT Dec 21, 1999

US-PAT-NO: 6006175
DOCUMENT-IDENTIFIER: US 6006175 A

TITLE: Methods and apparatus for non-acoustic speech characterization and recognition

DATE-ISSUED: December 21, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Holzrichter; John F.	Berkeley	CA		

US-CL-CURRENT: 704/208; 704/205, 704/206, 704/207

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw. Desc | Image

☐ 3. Document ID: US 5497766 A

L10: Entry 3 of 7 File: USPT Mar 12, 1996

US-PAT-NO: 5497766
DOCUMENT-IDENTIFIER: US 5497766 A

TITLE: Ventilator and care cart each capable of nesting within and docking with a hospital bed base

DATE-ISSUED: March 12, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Foster; L. Dale	Brookville	IN		
Reeder; Ryan A.	Brookville	IN		

US-CL-CURRENT: 128/200.24; 128/204.18

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 4. Document ID: US 5457831 A

L10: Entry 4 of 7 File: USPT Oct 17, 1995

US-PAT-NO: 5457831
DOCUMENT-IDENTIFIER: US 5457831 A

TITLE: Ventilator, care cart and motorized transport each capable of nesting within and docking with a hospital bed base

DATE-ISSUED: October 17, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Foster; L. Dale	Brookville	IN		
Reeder; Ryan A.	Brookville	IN		

US-CL-CURRENT: 5/510; 5/503.1

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 5. Document ID: US 5337845 A

L10: Entry 5 of 7 File: USPT Aug 16, 1994

US-PAT-NO: 5337845
DOCUMENT-IDENTIFIER: US 5337845 A

TITLE: Ventilator, care cart and motorized transport each capable of nesting within and docking with a hospital bed base

DATE-ISSUED: August 16, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Foster; L. Dale	Brookville	IN		
Reeder; Ryan A.	Brookville	IN		

US-CL-CURRENT: 180/11; 180/13, 180/19.1, 180/65.1, 5/510

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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6. Document ID: US 5335651 A

L10: Entry 6 of 7 File: USPT Aug 9, 1994

US-PAT-NO: 5335651
DOCUMENT-IDENTIFIER: US 5335651 A

TITLE: Ventilator and care cart each capable of nesting within and docking with a hospital bed base

DATE-ISSUED: August 9, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Foster; L. Dale	Brookville	IN		
Reeder; Ryan A.	Brookville	IN		

US-CL-CURRENT: 128/202.13; 128/202.27, 128/897, 248/129, 296/20, 5/2.1, 5/503.1, 5/658

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw. Desc | Image

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7. Document ID: US 4859948 A

L10: Entry 7 of 7 File: USPT Aug 22, 1989

US-PAT-NO: 4859948
DOCUMENT-IDENTIFIER: US 4859948 A

TITLE: Device for positioning a sample carrier in an NMR spectrometer

DATE-ISSUED: August 22, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Kuster; Anton	Greifensee			CH

US-CL-CURRENT: 324/318; 324/300

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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Term	Documents
AIR.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2231560
AIRS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1368
FLOW$4	0
FLOW.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2246438
FLOWA.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	26
FLOWAALE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
FLOWABE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2
FLOWABEL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2
FLOWABI.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	4
FLOWABIE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	3
FLOWABIL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
(L9 AND (FLOW$4 WITH AIR)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	7

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L10: Entry 7 of 7 File: USPT Aug 22, 1989

DOCUMENT-IDENTIFIER: US 4859948 A
TITLE: Device for positioning a sample carrier in an NMR spectrometer

Abstract Text (1):
In the case of NMR spectrometers comprising a cryomagnet with vertical axis, the sample to be examined is introduced into the measuring area of the magnet by means of a sample carrier which is arranged in a guide tube passing axially through a central space of the craymagnet, and can be moved therein by means of a flow of compressed air. For changing the sample, one switches on the compressed air flow so that the sample carrier is raised to the upper end of the guide tube where the sample can be changed. With increasing sizes of the cryomagnets, the upper end of the guide tube is no longer accessible without an aid (ladder or platform). The invention therefore provides that a direction switch is arranged at the upper end of the guide tube and that an inclined tube extends from the said direction switch to an easily accessible point, for inserting and removing the sample carrier at its end. By guiding the flow of compressed air in a suitable manner and switching over the direction switches as required, the sample can then be moved from the measuring area to the end of the inclined tube, and vice versa, so that the difficulties described before are no longer encountered.

Brief Summary Text (1):
The present invention relates to a device for positioning a sample carrier in an NMR spectrometer comprising an intense-field cryomagnet with vertically arranged axis producing a homogeneous static magnetic field in a predetermined measuring area, and a vertical guide tube passing through the said measuring area and carrying at its upper end a sample-changing device for transporting and removing a sample carrier to or from the guide tube, and comprising further and arrangement for supplying pressurized gas to the lower end of the guide tube by means of which the gas supplied to the guide tube can be measured in such a manner that a sample carrier, having been transferred to the guide tube, can be selectively lowered from the upper end of the guide tube to the measuring area of the cryomagnet, for performing a measurement, and raised subsequently to the upper end of the guide tube for removing the sample carrier.

Brief Summary Text (2):
A device of this type has been previously known, for example from U.S. Pat. No. 45 81 583 and EP 01 97 791 A2. The sample-changing device of the one of these devices consists of a magazine comprising a rotating sample holder with nests intended for receiving sample carriers and adapted for being positioned above the end of the guide tube, while the other device comprises a robot arm for removing sample carriers from a magazine and transferring them to the guide tube, and vice versa. However, these devices are complex and do not lend themselves for economic use when samples are to be examined individually, not in series.

Brief Summary Text (3):
Where the sample carriers are not positioned automatically, it is a disadvantage of the device for introducing or removing the sample into or out of the measuring area of the cryomagnet of an NMR spectrometer, which is sometimes also described as "automatic lift", that in the case of big magnet arrangements the upper end of the guide tube is no longer accessible for the user of the spectrometer from the floor of the room where the magnet arrangement is installed. For changing the sample, the user then has to use a ladder, or a platform must be built up beside the magnet arrangement. However, quite apart from the fact that the necessity to use a ladder is troublesome and the arrangement of a platform is expensive, the necessary space

for the erection of a ladder or a platform must be available beside the magnet arrangement. This may lead to considerable restrictions when selecting the location for the magnet arrangement. In addition, any environmental variations over time that might influence the very intense magnetic field and the sensitive measuring equipment of the NMR spectrometer should be avoided, and man should also as far as possible keep clear of the intense magnetic field which constitutes a certain danger. Under these aspects, too, certain problems are encountered in the case of the before-mentioned devices, on the one hand in connection with the loading of the sample holders arranged at the upper end, and on the other hand as regards the robot operating in the direct neighborhood of the cryomagnet.

Brief Summary Text (4):
Now, it is the object of the present invention to design a device of the type described above in such a manner that the sample can be changed by the user of the NMR spectrometer from an easily accessible point and that no significant additional space is required for such a device.

Brief Summary Text (5):
This object is achieved according to the invention by the fact that the sample-changing device comprises an inclined tube leading from a point neighboring the upper end of the guide tube to an easily accessible point outside the magnet arrangement where it is provided with an opening with a closure for inserting and removing the sample carrier, and further a direction switch comprising a tube section that can be brought into alignment selectively with the guide tube or with the inclined tube, and that the device for supplying the pressurized gas can be connected also to the closed lower end of the inclined tube and controlled in such a manner that the sample carrier, after having been raised in the guide tube into the area of the direction switch in the condition where the tube section is aligned with the guide tube, can be lowered for removing the sample, after changing-over the position of the direction switch in the inclined tube, and vice versa.

Brief Summary Text (6):
Accordingly, it is ensured in the case of the magnet arrangement according to the invention that once the sample has been raised by means of the guide tube to a point above the magnet structure it can be lowered by means of the inclined tube along the outside of the magnet structure to a point which is easily accessible for the user of the spectrometer. This point may be in the direct neighborhood of the spectrometer console, i.e. in the direct neighborhood of the normal workplace of the user of such a spectrometer. The design of the sample transport system requires no notable additional space, nor any expensive or complicated additional arrangements. This is true in particular when air is used as gas for transporting the sample. Another suitable gas is nytrogen which is available as pressurized gas in cylinders. Whenever the term "compressed air" is used hereafter, it is meant to include any suitable pressurized gaseous medium.

Brief Summary Text (7):
Inserting and removing the sample carrier at the lower end of the inclined tube may be facilitated if a unilaterally closed, detachable end piece comprising a chamber for receiving the sample carrier is arranged at the lower end of the inclined tube. This end piece is of course designed in such a manner that the sample carrier is easily accessible for insertion and removal, and is safely retained in the end piece. The connection between the end piece and the inclined tube may be realized, for example, by means of a bayonet closure, or else by a resilient click-on connection, or the like.

Brief Summary Text (8):
For controlling the movement of the sample carrier only three operating conditions are required for the compressed-air system, just as in the arrangements known heretofore, namely one for raising the sample, one for lowering the sample and one causing it to be held in a floating condition if, according to a further improvement of the invention, the direction switch comprises a movable section for closing the other tube tightly when the tube section of the direction switch is in alignment either with the guide tube or with the inclined tube, and if in addition the guide tube is connected to the closed end of the end piece by a flexible line connected to the guide tube at a distance from its upper end which is at least equal to the length of the sample carrier. Depending on the switching position, the sample carrier is then raised and lowered in the guide tube or the inclined tube, it being simultaneously ensured that the sample carrier can be transferred from the respective tube to the direction switch, and vice versa, only when the direction

switch is in correct alignment with the respective tube.

Brief Summary Text (11):
The sample transport system may of course be equipped with additional features making its operation even more convenient for the user, if the expense caused by such arrangements is regarded as justified. Especially in cases where the inclined tube is to end in the area of the console of the spectrometer, the end piece arranged at the inclined tube may be the tube section of another rotary direction switch connected to a substantially vertical, upwardly open sample-receiving tube. This upwardly open sample-receiving tube may end, for example, in the table top of a console in which case the sample carrier can be positioned very easily in the receiving tube from above. The overall arrangement may then be designed in such a manner that a sample which has been ejected from the magnet will project beyond the upper end of the receiving tube so that it can be easily gripped and removed.

Brief Summary Text (12):
The additional direction switch may be mechanically coupled in this case with the direction switch arranged at the upper end of the guide tube in order to ensure that the tube sections of both direction switches are in alignment with the inclined tube every time the sample carrier is to be transported from the one direction switch to the other. However, such an arrangement would also provide the possibility to have the direction switch and the means for supplying compressed air automatically adjusted, i.e. controlled, by a control unit in response to sensors arranged in the area of the direction switches so that for inserting or removing a sample it would be necessary only to actuate a switch on the console whereby all necessary operations would be initiated.

Drawing Description Text (2):
FIGS. 1 and 2 show diagrammatic representations of a magnet arrangement equipped with a sample transport system according to the invention.

Detailed Description Text (1):
In the arrangement shown in FIG. 1 the central space 1 of a cyromagnet 2--indicated only diagrammatically--is passed by a guide tube 3 containing a sample carrier 4. The cryomagnet 2 is part of an NMR spectrometer intended for examining a sample 5 which has been transported, by means of the sample carrier 4, into the homogeneous area of the magnet field generated by the cryomagnet 2. The means for transporting the sample carrier 4 into this homogeneous area of the magnetic field, which is found approximately at the center, but frequently also below the center, of the cryomagnet 2, is compressed air which is supplied to the guide tube 3 from a system 6 which is connected to the lower end of the guide tube by means of a tube 7 and which also serves to remove the sample carrier 4, together with the sample 5, later from the measuring area of the cryomagnet 2. The quantity of compressed air supplied may be increased for this purpose in such a manner that the sample carrier 4 is carried to the upper end of the guide tube 3 where a direction switch 11 is arranged comprising a cylindrical housing 12 and a rotary slide 13 mounted therein and comprising a tube section 14 which, in the position of the rotary slide 13 shown in FIG. 1, is in alignment with the guide tube 3. The arrangement 6 serving for supplying compressed air may consist of a blower, a compressor, a compressed-air tank, or the like. It is further understood that the expression "compressed air" which is used herein for the sake of simplicity is meant to describe also any other compressed gas. In fact, one often uses nytrogen in practice, in which case the arrangement 6 consists simply of a nytrogen cylinder.

Detailed Description Text (5):
It is readily seen that in the position of the rotary slide 13 illustrated in FIG. 1 the sample carrier 4 can be raised in the guide tube by increasing the compressed-air supply until the sample carrier reaches the upper end of the tube section 14 which in this position is in alignment with the guide tube 3. An opening 31 provided at the end of the tube section 14 permits the air, which is pressed upwardly and out of the guide tube 3 by the rising sample carrier 4, to escape in a controlled manner while an opening 32 provided at a certain distance from the end of the tube section 14 permits the compressed air to escape after the sample carrier 4 has passed this opening so that the sample carrier will not be subjected to excessive pressure in its upper end position, while being on the other hand safely retained also in this position. The compressed air supplied to the inclined tube 15 via line 19 at the lower end of the end piece 17 remains without effect in the position illustrated in the drawing because the upper end of the inclined tube 15 is blocked in this position by the rotary slide 13 of the direction switch 11. Now,

when the rotary slide 13 of the direction switch 11 is rotated, by corresponding actuation of the connecting rod 22, the end of the tube section 14 located inside the rotary slide 13 is moved into the area of the opening of the inclined tube 15 before the connection with the guide tube 3 is fully interrupted. This means that during a certain transition phase the sample carrier 4 is held in the tube section 14 by compressed air supplied partly via the guide tube 3 and partly via the inclined tube 15. Once the rotary slide 13 has reached the position shown in the drawing by dash-dotted lines, in which the tube section 14 is in alignment with the inclined tube 15, the sample carrier 4 is subjected to the action of compressed air which, although being supplied to the guide tube 3, flows through the line 19 and the end piece 17 into the inclined pipe 15 and from there into the tube section 14 as the guide tube 3 is now blocked at its upper end by the rotary slide 13. By reducing the supply of compressed air, the sample carrier can now be lowered into the end piece 17 provided at the lower end of the inclined pipe 15 in the same manner in which the sample carrier is lowered into the measuring area. One then only has to take off the end piece 17 for removing the sample carrier 4, together with the sample 5, from the sample-receiving space provided for this purpose in the end piece 17, and for exchanging it against another sample carrier with a new sample. Once the end piece 17 has been attached again, the sample carrier can then be raised again into the tube section 14 of the direction switch 11, by increasing the compressed-air supply correspondingly, and then lowered in the usual manner into the measuring area of the cryomagnet 2 by pulling the connecting rod 22 to actuate the direction switch 11.

Detailed Description Text (6):
The described arrangement provides a high degree of operating safety, in spite of its very simple design. For example, a sample carrier located in the end piece 17 can be moved to the direction switch only when the tube section 14 is aligned with the inclined tube 15, because otherwise, as will be readily seen from FIG. 1, the compressed air supplied to the guide tube will escape through the openings 31, 32 in the tube section 14 communicating with the guide tube 13, while on the other hand the inclined tube 15 cannot accept any air being closed at its upper end by the rotary slide 13. If, however, the direction switch 11 is set to the inclined tube 15 while the sample carrier is located in the guide tube 3, then the sample carrier 4 may in fact be raised when the compressed-air supply is increased, but only so long as it remains below the connection 33 for the flexible line 19, because the air which is displaced by the sample carrier 4 can escape through the line 19 and the upwardly open inclined pipe 15; the compressed air supplied to the guide tube 3 will, however, escape in the same manner as soon as the sample carrier 4 has passed the before-mentioned connection and will then have no significant effect because a cushion of condensed air is formed above this connection, in the section of the guide tube blocked by the rotary slide 13, which keeps the sample carrier away from the rotary slide 13 of the direction switch 11.

Detailed Description Text (7):
The invention illustrated in FIG. 2 comprises again a cryomagnet 41 whose central space 42 is passed by a guide tube 43 which serves for transporting a sample carrier 44, together with its sample, into the homogeneous area of the magnetic field generated by the cryomagnet 41. The sample carrier 44 is again moved in the guide tube 43 by compressed air which is supplied to the lower end of the guide tube 43 by a corresponding arrangement 46, via a tube 47.

Detailed Description Text (8):
However, this embodiment comprises, on the one hand, a direction switch 51 provided at the upper end of the guide tube 43 and consisting, in the manner described before, of a housing 52 and a rotary slide 53 mounted to be rotated inside the said housing whereby a tube section 54 arranged in the rotary slide can be brought into alignment selectively with the guide tube 43 or an inclined tube 55 opening into the housing 52 of the direction switch 51, and on the other hand an additional direction switch 61 consisting likewise of a cylindrical housing 62 and a rotary slide accommodated therein and provided with a tube section 64 that can be brought into alignment selectively either with the inclined tube 55 or with a sample-receiving tube 65 opening into the housing 62 of the direction switch 61. The sample-receiving tube 65 extends substantially in vertical direction and may, for example, pass through the table top of the console or the control panel of the spectrometer of which the cryomagnet 41 forms a part. It will be readily seen that this arrangement provides the possibility to insert a sample carrier into the sample-receiving tube 65 from above, to lower it into the tube section 64 of the lower direction switch 61, to transport is thereafter--after the direction switch 61, 51 has been set

correspondingly-- via the inclined tube 55 into the tube section 54 of the upper direction switch, and to lower it finally, after the upper direction switch 51 has been actuated, into the guide tube 63 and there down to the homogenous area of the magnetic field generated by the cryomagnet 41, for carrying out the desired measurements.

Detailed Description Text (9):
There is no need to explain that the direction switches and the compressed-air supply may be operated manually, just as in the case of the embodiment illustrated in FIG. 1, and that it is also possible to couple mechanically the two direction switches provided at the upper and lower ends of the inclined tube 55. Likewise, it will be readily seen that the whole sample-changing process, from the insertion of a sample carrier into the sample-receiving tube 65, up to the positioning of the sample carrier in the measuring area of the cryomagnet 41 and, after completion of the measurement, the removal of the sample carrier from the measuring area and its deposition in the sample-receiving tube 65, can be controlled in response to control demands supplied by a control unit. The arrangement shown in FIG. 2 is adapted for such an automatic sample-changing process. To this end, the rotary slides 53 and 63 of the two direction switches 51 and 61 are provided each with one crank arm 71 and 72, respectively, whose ends are pivotally connected to the piston rods 73 and 74, respectively, of pneumatic cylinders 75 and 76. The pneumatic cylinders 75, 76 are supplied with compressed air from the arrangement 46 via lines 77 and 78. Control valves 81, 82 and 83, 84, respectively, determine if the compressed air is supplied to the forward or rear end of the piston of the pneumatic cylinder 75 or 76 and, accordingly, the direction in which the direction-changing switch is displaced. In the case of this embodiment of the invention, compressed air is supplied separately to the guide tube 43 and to the tube section 64 of the direction switch 61 arranged at the lower end of the inclined tube 55. The connection between the unit 46 supplying the compressed air and the tube section 64 is established by a flexible line 85. The supply of compressed air to the guide tube 43 and the tube section 64 is also controlled by a control valve 46 or 47 arranged in the corresponding line. When triggered by an external control command, by which a sample transport process is started, the control unit 67 initiates the steps required for introducing the sample carrier 44 from the sample-receiving tube 65 into the measuring position or for discharging the sample carrier from the measuring position to the sample-receiving tube 65, i.e. the steps of dosing the compressed air and reversing the direction switches, as described above in connection with FIG. 1, except that in the present case an additional step is required when the sample passes the direction switch 61. The individual steps of the sample transport process may be monitored by sensors 87, 88, 89 responding to the presence of the sample carrier 44 in the sample-receiving tube 65, in the tube section 64 of the lower direction switch 61, and in the tube section 54 of the upper direction switch 51. Such monitoring may in particular serve the purpose to ensure that the direction switches will not change position unless the sample carrier occupies one of these positions. The sensors 87 to 89 may simply consist of optical sensors which can be fitted particularly easily when the tubes of the device consist of a transparent material, in particular a transparent plastic material. In any case, the use of a transparent plastic material for the manufacture of the tubes of the device provides the advantage that the position of the sample and the operation of the device can be permanently supervised by visual inspection. Of course, the components of the direction switches may also be made from a transparent plastic material.

Detailed Description Text (10):
It is understood that the invention is not limited to the embodiments shown in the drawing, but that numerous variations may be made without leaving the scope and intent of the invention, it being essential for the invention that the use of direction switches and of tubes extending in a direction different from that of the guide tube passing through the cryomagnet enables the sample carrier to be transported to a position where the sample carrier can be easily positioned in, or removed from the end of the tube ending at this point. This may be achieved also, to a certain degree, by flexible and/or curved tubes, although it should, if possible, be avoided with respect to the arrangement of the sample that the sample carrier is turned upside down during its movement. As regards the supply of air and the position of the direction switches it is a matter of course that the individual tube portions must be passed by the sample carrier successively in the direction to or from the measuring area and that the direction switches must be set in each case to allow such movement. It is also a matter of course that the direction switches may be differently designed and/or may be operated by different actuating means, for example by means of Bowden cables, even though the switching means according to the

invention distinguish themselves by a particularly simple and space-saving design.

Other Reference Publication (1):
Rev. Sci. Instrum. 57(3), Mar. 1986, A. Bielecki, D. B. Zax, K. W. Zilm and A. Pines: "Zero-field NMR and NQR and NQR spectrometer", pp. 393-403.

CLAIMS:

1. Device for positioning a sample carrier in an NMR spectrometer comprising an intense-field cryomagnet with vertically arranged axis producing a homogeneous static magnetic field in a predetermined measuring area, and a vertical guide tube passing through the said measuring area and carrying at its upper end a sample-changing device for transporting and removing a sample carrier to or from the guide tube, and comprising further and arrangement for supplying pressurized gas to the lower end of the guide tube by means of which the gas quantity supplied to the guide tube can be measured in such a manner that a sample carrier, having been transferred to the guide tube, can be selectively lowered from the upper end of the guide tube to the measuring area of the cryomagnet, for performing a measurement, and raised subsequently to the upper end of the guide tube for removing the sample carrier,

characterized in that

the said sample-changing device comprises an inclined tube leading from a point neighboring the upper end of the guide tube to an easily accessible point outside the said magnet arrangement where it is provided with an opening with a closure for inserting and removing the said sample carrier, and further a direction switch comprising a tube section that can be brought into alignment selectively with the said guide tube or with the said inclined tube, and that the device for supplying the pressurized gas is connected also to the closed lower end of the said inclined tube and can be controlled in such a manner that the said sample carrier, after having been raised in the said guide tube into the area of the direction switch in the condition where the tube section is aligned with the guide tube, can be lowered for removing the sample, after changing-over the position of the direction switch in the inclined tube, and vice versa.

2. Device according to claim 1, characterized in that a unilaterally closed, detachable end piece comprising a chamber for receiving the said sample carrier is arranged at the lower end of the said inclined tube.

4. Device according to claim 2, characterized in that the said end piece is formed by the tube section of another direction switch which is connected to an upwardly open tube intended for receiving the sample carrier and extending substantially in vertical direction.

8. Device according to claim 1, characterized in that the said direction switch and the means for supplying compressed air are automatically adjusted, i.e. controlled, by a control unit in response to sensors arranged in the area of the direction switches.

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☐ 1. Document ID: US 20020068865 A1

L13: Entry 1 of 6 File: PGPB Jun 6, 2002

PGPUB-DOCUMENT-NUMBER: 20020068865
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DOCUMENT-IDENTIFIER: US 20020068865 A1

TITLE: Method and apparatus for magnetic resonance arteriography using contrast agents

PUBLICATION-DATE: June 6, 2002

INVENTOR-INFORMATION:

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US-CL-CURRENT: 600/415; 600/420

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 2. Document ID: US 6311085 B1

L13: Entry 2 of 6 File: USPT Oct 30, 2001

US-PAT-NO: 6311085
DOCUMENT-IDENTIFIER: US 6311085 B1

TITLE: Method and apparatus for magnetic resonance arteriography using contrast agents

DATE-ISSUED: October 30, 2001

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US-CL-CURRENT: 600/420; 324/306, 600/415

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 3. Document ID: US 5924987 A

L13: Entry 3 of 6 File: USPT Jul 20, 1999

US-PAT-NO: 5924987
DOCUMENT-IDENTIFIER: US 5924987 A

TITLE: Method and apparatus for magnetic resonance arteriography using contrast agents

DATE-ISSUED: July 20, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Meaney; James F. M.	Leeds LS29NS			GB
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US-CL-CURRENT: 600/420; 324/306, 600/415

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 4. Document ID: US 5602477 A

L13: Entry 4 of 6 File: USPT Feb 11, 1997

US-PAT-NO: 5602477
DOCUMENT-IDENTIFIER: US 5602477 A

TITLE: Nuclear magnetic resonance freezing sensor

DATE-ISSUED: February 11, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
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Reid; David S.	Davis	CA		

US-CL-CURRENT: 324/315; 324/300

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 5. Document ID: US 5035231 A

L13: Entry 5 of 6 File: USPT Jul 30, 1991

US-PAT-NO: 5035231
DOCUMENT-IDENTIFIER: US 5035231 A

TITLE: Endoscope apparatus

DATE-ISSUED: July 30, 1991

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Kubokawa; Hiroaki	Hachioji			JP
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Ueda; Yasuhiro	Kokubunji			JP
Ohshima; Yutaka	Hachioji			JP
Nakamura; Takeaki	Hino			JP
Hibino; Hiroki	Hachioji			JP
Takayama; Shuichi	Hachioji			JP
Hagino; Tadao	Yokohama			JP

US-CL-CURRENT: 600/109; 600/411

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

6. Document ID: US 4960106 A

L13: Entry 6 of 6 File: USPT Oct 2, 1990

US-PAT-NO: 4960106
DOCUMENT-IDENTIFIER: US 4960106 A

TITLE: Endoscope apparatus

DATE-ISSUED: October 2, 1990

INVENTOR-INFORMATION:

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Nakamura; Takeaki	Hino			JP
Ohshima; Yutaka	Hachioji			JP
Hibino; Hiroki	Hachioji			JP
Takayama; Shyuichi	Hachioji			JP
Hagino; Tadao	Yokohama			JP

US-CL-CURRENT: 600/104; 600/116, 600/127, 600/422

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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Term	Documents
PLASTIC.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1086757
PLASTICS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	423531
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CERAMICS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	135549
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ONS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	2987
"NON METALLIC$4"	0
"NON MAGNETIC$4"	0
NONMETALLIC$4	0
NONMETALLIC.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	15148
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(L12 AND (PLASTIC OR CERAMIC OR NONMETALLIC$4 OR NONMAGNETIC$8 ON NON-METALLIC$4 OR NON-MAGNETICAL$4 OR "NON METALLIC$4" OR "NON MAGNETIC$4")).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	6

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L13: Entry 4 of 6 File: USPT Feb 11, 1997

DOCUMENT-IDENTIFIER: US 5602477 A
TITLE: Nuclear magnetic resonance freezing sensor

Abstract Text (1):
A non-invasive apparatus and method for determining changes in the enthalpy of an object undergoing a freezing cycle using nuclear magnetic resonance (NMR) imaging (NMRI) techniques. Enthalpy is determined from the position of the ice interface of said object or, alternatively, from the liquid/solid ratio of the object.

Brief Summary Text (4):
This invention pertains generally to monitoring and controlling the freezing of foods, and more particularly to a non-invasive apparatus and method for using nuclear magnetic resonance imaging to determine the ice interface in the object which, together with the air temperature and air velocity, are used to measure enthalpy in food freezing operations. Alternatively, enthalpy can be measured from the ratio of liquid to solid portions of the object determined from nuclear magnetic resonance imaging or, for objects of substantially symmetrical geometric shape, from the liquid/solid ratio obtained by integrating the amplitude of nuclear magnetic resonance signals.

Brief Summary Text (13):
or 147 kJ/lb. The true refrigeration load in a freezer is larger, as heat may be gained from the surroundings through insulation leaks and air changes, or through waste heat from lights, motors, or even people. As a conservative estimate, we assume these add 10% to the refrigeration load, or

Brief Summary Text (16):
Typically, there is about a 30% additional energy cost from such things as circulating air through blast freezers or moving product on conveyors. This increases electrical consumption to

Brief Summary Text (25):
Traditionally, the primary means of measuring or predicting food freezing rates have been through thermometric measuring during freezing, or mathematical modelling. In the former, the time required for a given temperature change to occur is assessed by placing thermocouples within a sample during freezing. This provides a recorded history of temperature profiles within the sample. Freezing rate has been defined in several ways, such as by dividing the surface to center distance by the time required to reach 0.degree. C. and the thermal center to reach 5.degree. C. below the freezing temperature. More common, however, is the concept of "freezing time" such as the time required for the slowest cooling point to decrease from 0.degree. C. to -5.degree. C. Use of thermocouples, however, is undesirable since they may provide additional heat conduction paths to the same or alter air flow patterns. Additionally, such an approach does not measure the variable of most interest, namely the change in enthalpy with time.

Brief Summary Text (30):
By way of example, and not of limitation, the present invention generally comprises a non-invasive apparatus and method for determining changes in the enthalpy of an object undergoing a freezing cycle from the location of the ice interface using nuclear magnetic resonance (NMR) imaging (NMRI) techniques, combined with the air velocity and air temperature measurements. The NMR image data, air velocity data, and air temperature data are calibrated by utilizing a calorimeter to enable enthalpy measurements during the transient and steady-state parts of freezing. As result, the position of the ice interface can be correlated to the enthalpy of the

object. Further, images of the total liquid portion and the total solid portion of the object can be acquired or, alternatively, for objects of substantially symmetrical geometric shape NMR signal amplitudes can be integrated to determine liquid and solid portions of the object, and the enthalpy determined through a correlation of the ratio of frozen/unfrozen portions of the product with the calorimetric enthalpy unique to the freezing conditions. The enthalpy of the object is then used to control the food freezing operation.

Brief Summary Text (31):
The present invention provides for measurement of enthalpy during the transient and steady-state parts of freezing. Advance of the ice interface has until now been impossible to visualize except in clear solutions. The present invention, however, employs nuclear magnetic resonance imaging techniques to follow the formation of ice. By correlating NMR imaging with calorimetry, the present invention providers an in-line, non-invasive sensor for monitoring energy flow during food freezing.

Brief Summary Text (32):
The apparatus of the present invention generally comprises an RF probe encircling a conveyor, tube or the like which is carrying the product to be frozen, a plurality of magnets for generating a magnetic field around the conveyor, magnetic field gradient coils positioned between the magnets and the RF probe, a power supply for the gradient coils, a transmitter and receiver coupled to the RF probe, and a central processing unit coupled to the transmitter and receiver and gradient coil power supply. In operation, an image of the liquid protons from the water phase is acquired using a standard NMR imaging pulse sequence to measure the spatial distribution of spins, which is repeated N-1 times (where N is usually a power of 2). The interface location is then measured using standard edge detection techniques. The location of the interface, air velocity, and air temperature are used in conjunction with a calibration based on differential calorimetry measurements to determine enthalpy. For objects of substantially symmetrical geometric shape, imaging is unnecessary and the integrated amplitude of NMR signals can be used to determine the liquid and solid portions of the object. The ratio of liquid to solid portions of the object, air velocity, and air temperature are used in conjunction with a calibration based on differential calorimetry measurements to determine enthalpy. The change in enthalpy is then compared to that required for successful operation of the freezing system.

Drawing Description Text (3):
FIG. 1 is schematic diagram of a nuclear magnetic resonance freezing sensor in accordance with the present invention.

Drawing Description Text (4):
FIG. 2 is a timing diagram showing an NMR pulse sequence used in conjunction with the apparatus shown in FIG. 1.

Detailed Description Text (2):
FIG. 1 schematically depicts a nuclear magnetic resonance freezing sensor 10 in accordance with the present invention. Magnetic resonance results from the interaction between atomic particles, electrons and the nuclei, and an external magnetic field. This interaction is similar to that observed when iron filings are placed near a bar magnet. The filings become oriented and a magnetic field is induced in the metal. However, unlike the physical motion of the filings, the physical orientation of the atomic particles is not altered. Only the magnetic moment of the atomic particles is influenced (at most common magnetic field strengths). Resonance is observed in these systems because they absorb and emit energy at specific frequencies. The specific frequency depends on the individual atomic particle and the strength of the applied magnetic field. When the atomic particle is a nucleus the phenomenon is termed Nuclear Magnetic Resonance (NMR). Not all nuclei exhibit magnetic resonance, however. A nuclei has a magnetic moment only if the spin angular moment is non-zero.

Detailed Description Text (3):
Nuclear magnetic resonance imaging (NMRI) is an NMR technique which provides spatial localization of the NMR signals from a sample. Signals from many neighboring spatial locations are used to generate an image of nuclei density or some other property. NMRI is based on degrading the homogeneity of the external magnetic field in a specific way, resulting in a known frequency variation across the sample. This variation is usually achieved by applying a linear magnetic field gradient. If the effects of the shielding constant are ignored, the frequency of excitation and

detection for an NMR experiment, .upsilon., is given by the Larmor equation, .upsilon.=.gamma.B.sub.o /2.pi., where .gamma. is the gyromagnetic ratio and B.sub.o is the magnetic field strength. By applying a linear field gradient in the z direction, the frequency becomes a function of position: .upsilon.(z)=.gamma.(B.sub.o +g.sub.z z)2.pi. where g.sub.z is the strength of the magnetic field gradient in the z direction. Using three orthogonal gradients during an NMR pulse sequence a two or three dimensional NMR image can be acquired. The principal advantage of NMRI is that the sample is unaffected by the measurement (at common magnetic field strengths) and opaque systems can be studied.

Detailed Description Text (4):
It is possible to use NMRI to measure changes in enthalpy in moving and stationary systems using pulse sequences capable of spatially encoding the NMR signal wherein the products are subjected to a constant magnetic field of strength B.sub.o and a magnetic field gradient, g. After the spin systems have aligned with the imposed magnetic fields, they are disturbed by a radio frequency pulse that "tags" a region of the movement. Phase encode imaging produces direct images for stationary, uni-directional and more complex movement. In the case of one-dimensional, steady movement, this technique can be described as follows. Letting z(t) be the position of a spin at time t, then, z(t)=Z.sub.0 +w t where Z.sub.0 is the position of the spin at time zero and w is the velocity of the spin. We call g.sub.z the applied magnetic field gradient in the flow direction, then, use Bloch equations to show that the phase of the magnetization is given by ##EQU3## where m.sub.0 and m.sub.1 are the zeroth and first moments of the gradient, respectively, namely, ##EQU4## The applied gradient is designed such that m.sub.o .noteq.0 but m.sub.1 =0. Under these conditions, the phase angle is proportional to the position of the spin and is not influenced by the velocity of the spin. Just as the phase of the magnetization can be used to measure the spin density distribution in standard NMRI, a properly designed gradient allows the spin density distribution in a moving object to be measured in a sample.

Detailed Description Text (5):
As can be seen from FIG. 1, the NMR freezing sensor 10 in accordance with the present invention is situated adjacent to a conveyor 12 on which a food product 14 moves and which should have a sufficient entrance length 16 from any product source to hold the products to be evaluated. Permanent magnets 18a, 18b are radially positioned on each side of conveyor 12 to establish a magnetic field through the product 14, one magnet having its north pole facing the conveyor 12 and the other magnet having is south pole facing the conveyor 12. Conveyor 12 extends through an RF probe 20, and gradient field coils 22a, 22b are positioned between magnets 18a, 18b and RF probe 22, respectively. In order to minimize the generation of unwanted eddy currents in magnets 18a, 18b, gradient field coils 22a, 22b (and hence RF probe 20) should be physically separated from magnets 18a, 18b by a distance sufficient to prevent coupling or the gradient field coils should be shielded. Preferably, the gradient rise/fall times should be sufficiently fast so as to allow for gradient waveforms which compensate for velocity and acceleration (m.sub.1 =0 and m.sub.2 =0). Also included is a power supply 24 for powering gradient field coils 22a, 22b. A control processor 26, which can be a central processing unit, microcomputer or the like, is used to generate the pulse sequences, to control the acquisition of images, to evaluate the acquired images, and to determine the ice interface and enthalpy of the product. Control processor 26 is coupled to a transmitter/receiver 28 and power supply 24. Power supply 24 is coupled to gradient field coils 22a, 22b and transmitter/receiver 28 is coupled to RF probe 20. Magnets 18a, 18b, RF probe 20, gradient field coils 22a, 22b, power supply 24, and transmitter/receiver 28 can be of a type used in conventional nuclear magnetic resonance imaging or spectroscopy equipment.

Detailed Description Text (6):
Referring to FIG. 2, an exemplary sequence of the RF and gradient pulses used to generate the NMR images is shown. This sequence can be tailored so as to provide optimal data for any product flow rate by setting the gradients such that the NMR signal recorded encodes only intensity and position, and the maximum position measured is just slightly larger than the product of interest. The field of view in each direction would be set to be just greater than the maximum length of the product in that direction. The frequency encode direction would have the minimum field of view necessary to prevent aliasing of the image. The sequence is repeated N-1 times (where N is usually a power of 2). Gradient pulse g would change in magnitude for each repetition from -g to g. The maximum value of g is set by the field of view in the phase encode direction. Gradients for the selective pulse and

frequency encoding may be velocity compensated if necessary to reduce artifacts in the final image. Gradient pulses for the pulse sequence in FIG. 2 are drawn without velocity compensation.

Detailed Description Text (9):
A variety of foods were placed within the confines of an NMR imaging coil and allowed to freeze. As freezing progressed, NMR images were collected at regular intervals in order to monitor spatial location of frozen and unfrozen water, air velocity and air temperature were recorded. In some experiments, thermocouples were placed along the central axis of the product to simultaneously map the time course of internal temperature profiles. In other experiments, samples were periodically removed from the freezer and placed immediately in a differential calorimeter. This allowed us to follow the amount of heat removed at any time during the freezing process.

Detailed Description Text (15):
All samples were weighed on a top loading electronic balance (PE 2000, Mettler Corp., Highstown, N.J.) prior to introduction to the freezer. This allowed us to normalize heat change and NMRI signal intensity data. Both three-dimensional and one-dimensional heat flow was studied. In the former case, samples were placed directly on a push rod and centered within the 10 cm tube through which cold air was circulated, so that air was allowed to reach the product on all sides. In the latter case, the sides perpendicular to the air flow were covered with 1/2" foam insulation; here, heat removal was primarily from the front and rear faces of the sample.

Detailed Description Text (18):
Two air blast freezers and one cryogenic freezer were used in these experiments. The air blast freezers were modified so that they could deliver cold air through an insulated 6 m section of PVC pipe (10.2 cm ID). The PVC pipe continued through the center of the NMRI bore, before returning to the intake of the freezer. The two mechanical freezers were a Frigoscandia (Sweden) laboratory air-blast freezer and a Conrad (Rockford, Ill) air-blast freezer. These gave air flows of 0-10 m/s at temperatures between -15.degree. C. and -35.degree. C. Air flow rate was controlled with a baffle which could be slid into the interior compartment of the freezer. Temperature was adjustable by means of a thermostat on the freezer.

Detailed Description Text (20):
The sample was introduced in the freezer by means of a push rod. The rod was equipped with a platform made of two 0.64 cm diameter wood dowels. These contacted the sample at two points and kept it suspended above the tube, and centered within the diameter of the tube. The rod was 1.2 m long and inserted after removing an endcap from where the PVC tube exits the magnet. A locating pin at the end opposite the sample fixes the sample so that it is directly within the confines of the imaging coil.

Detailed Description Text (25):
The sample chamber contained a heater constructed from 3.6 m of 0.25 mm diameter Teflon-coated constantan wire (Omega, Stamford, Conn.) wrapped around a 1.27 cm diameter plexiglass rod. The heater resistance was 36 ohms at room temperature. A mixer motor (Talboy Model 104, Emerson, N.J.) was mounted to the top of the cover, with a 9.5 mm diameter stainless steel shaft leading into the chamber and terminating in a 3-paddle mixer. A 7.5.times.10 cm trap door on the cover allowed samples to be introduced. To keep buoyant samples submerged in the water, a 3-sided plastic basket was fitted to a 6.3 mm plastic rod running through the chamber. The basket could be swivelled or raised and lowered in the chamber to trap the sample below the water.

Detailed Description Text (27):
The heater was powered by a 50 V power supply (VIZ Mfg., Philadelphia, Pa.). Voltage and current remained constant over the course of an experiment and were monitored by a built-in voltmeter and ammeter. A cross-check of power input was made by reading the voltage directly across the 36 ohm heater wire. The heater was turned on and off by a DPDT switch that activated a XL-10 cumulative timer (Kessler-Ellis, Atlantic Highlands, N.J.) whenever the heater was on. Care was taken such that heater leads and switches had minimal resistance (<0.1 ohms).

Detailed Description Text (31):
Temperatures within a sample were monitored by a series of thermocouples placed

along the sample axis parallel to the air flow. Four thermocouples were constructed from 0.010" diameter copper and constantan wire. A trial and error procedure was required to find the proper length of wire that caused the least noise in the NMR images. The thermocouples were inserted at approximately 7 mm intervals between the front surface and center of the sample. The leads were fed out through a 2 mm opening in the PVC pipe and directed to a Molytech 32-channel datalogger (Pittsburgh, Pa.). The datalogger was set to make recordings at times while images were not being taken. By staggering collection of temperature and NMR image data, the best image quality was maintained in the NMR images.

Detailed Description Text (33):
NMR Imaging

Detailed Description Text (34):
The sample was placed in the freezer tube and within a 10 cm homemade "birdcage" imaging coil. The coil size was selected so as to maximize the filling factor of the RF coils, thereby enhancing the signal-to-noise ratio of the data. NMR images were obtained using a General Electric CSI-2 Fourier Transform NMR Spectrometer, tuned to the hydrogen nuclear resonance frequency of 85.53 MHz and another General Electric CS1-2 Fourier Transform NMR Spectrometer tuned to a hydrogen nuclear resonance frequency of 25.9 MHz. The 30 cm horizontal bore of the 0.6-Tesla superconducting magnet permits imaging of objects having diameters up to 14.6 cm.

Detailed Description Text (39):
Data on interface position, heat removal, air temperature, air velocity and temperature profiles were compiled and analyzed in terms of an enthalpy-based freezing model which is available for PC and MacIntosh computers. This is a finite element model which solves the differential equation for enthalpy change involving a phase change: ##EQU5## where H is the enthalpy, t is time, T is temperature, and r is radial distance. The symbol m=0, 1, or 2 for rectangular, cylindrical, or spherical coordinates, respectively. The problem is approached by solving heat balance equations for each of the n nodes of a finite element grid. For the ith node at the jth unit of time, the enthalpy accumulated in the element is given by the difference between the heat flowing in and out of the element. Thus, ##EQU6## Where A is the cross-sectional area and V the volume of the element. At the surface (i=n), the conductive heat transfer term (kA.DELTA.T) is replaced by the convective heat transfer term (hA.DELTA.T). To solve this system of equations, the thermal properties of the material must be known as a function of temperature. These include the thermal conductivity k, the heat capacity C.sub.p, and the density r. These can be obtained from tables or estimated from the fat, water, and solids composition of the product. In addition to the material properties, the surface heat transfer coefficient h is required.

Detailed Description Text (42):
A. NMR Images During Freezing

Detailed Description Text (47):
With chicken legs, there were also indications of the contribution of fat to the NMR signal. In the images, signal intensity remained in the region of the bone and skin after freezing was complete. For the bone, this may be due to the relatively high lipid content in the bone marrow. Near the skin, there was an obvious subcutaneous layer of fat below the skin and above the muscle. Unlike the case with hot dogs, where fat is homogeneously distributed, the fat is structurally confined in the chicken. Thus, we could follow ice movement in the chicken leg and correlate it with the progress of freezing as studied by calorimetry.

Detailed Description Text (48):
For most foods examined, ice initially formed at the perimeter and moved towards the center of the product. In some cases, one-dimensional heat flow was examined by insulating the sides of the food parallel to the air flow. Here, the ice advanced as two interfacial fronts beginning at the front and rear surfaces of the product. The front interface moved at a rate faster than that developing from the rear side; the final loss in signal intensity occurred at a position behind the center of the product. This observation suggests that the rate of heat removal is not uniform over the whole product. In particular, the rate of heat transfer is greater at surfaces directly exposed to air flow. This reinforces the theory that the heat transfer coefficient (h), common to most heat transfer descriptions, is actually a value averaged over the entire surface of the product.

Detailed Description Text (51):
Two additional factors are noteworthy when assessing signal intensity and interface position. The first relates to the temperature dependency of the NMR signal. At lower temperatures, proton mobility is decreased as randomization of an initially polarized population of protons is diminished. This results in greater initial net magnetization. The signal intensity (S.sub.w) is inversely related to the absolute temperature by: ##EQU7## where .rho..sub.wl is the density of liquid water nuclei, TE is the echo time, T.sub.21 is the spin-spin relaxation time, and .theta. is the absolute temperature.

Detailed Description Text (53):
It was found that, at a given time, NMR signal intensity would vary in a region over which ice was still actively developing. Comparison of signal plots with and without 1/.theta. temperature correction, however, show that while the absolute value and temperature sensitivity would be expected to differ, the transitions between different regions still occurred at the same temperatures. At positions where T>T.sub.m, maximum liquid water exists and the signal is greatest. At temperatures T<T.sub.g ', maximum ice formation has occurred and the signal takes its lowest value.

Detailed Description Text (65):
One question of importance in food freezing is how much water remains unfrozen after steady-state freezing has been reached. The amount of unfrozen water can be determined both by calorimetry and NMR techniques. In these initial experiments, we wished to evaluate the use of the described differential compensated calorimeter for this purpose.

Detailed Description Text (70):
Most of the enthalpy change occurred soon after the sample was placed in the freezer. Temperature measurements of the sample showed that sample regions near the surface reached the freezing point within 5 to 10 minutes. For all samples, the heat removed rose steadily with time before reaching a steady state value. The time required to reach a steady-state varied with the product, freezer temperature, air speed, and type of freezer. In general, faster freezing was achieved with cryogenic freezing, lower temperature, higher air speed, and 3-dimensional versus 1-dimensional freezing.

Detailed Description Text (73):
After the freezing point was reached, temperatures tended to plateau before lowering further. This was more prominent at points farthest from the surface. This is indicative of a system undergoing a first order phase transition. The process is isothermal as heat is removed to change water into ice. As ice is formed in exterior regions, the thermal gradients for moving heat away from interior regions is reduced; thus, it takes longer to form a given volume of ice as freezing progresses. After approximately 120 mins, all temperatures converge. This corresponds to a low value of signal intensity in the NMR images.

Detailed Description Text (74):
Locations of the trailing end of the interface (as a function of the time spent in the freezer) were determined for beef roundsteak from the NMR images by measuring the distance between the bright areas and the edge of the slabs. Temperature profiles recorded with the thermocouples at three different locations along the freezing slabs indicated that the phase change occurs over a temperature range rather than at constant temperature.

Detailed Description Text (77):
Values of the convective heat transfer coefficent, h, depend on the velocity and physical properties of the air stream as well as the shape of the product. Ilicali and Saglam reported values between 13.8 and 64.8 W/m.sup.2 .degree.C. for freezing Golden Delicious apples. Mannaperuma and Singh, studying freezing of tylose spheres, reported h=300 W/m.sup.2 .degree.C. De Reinick and Schwartzberg reported h=15 to 22 W/m.sup.2 .degree.C. for beef patties. Considering the dependence of h on various factors, it is clear that the values found in this study are of similar magnitude, but may be high estimates when compared with the other results for beef.

Detailed Description Text (78):
Enthalpy removed during freezing per cross sectional area of a slab were simulated for various times spent in the freezer. The mathematical model assumes that the phase change is initiated between -1.degree. C. and -2.degree. C. Our observations

based on NMR images indicate that there is not a significant amount of ice formed until the temperature has reached -2.degree. C. The phase change appears to be essentially completed by the time the temperature reaches -5.degree. C. These observations are as expected and suggest that it may be possible to improve mathematical descriptions of the freezing interface by detailed analyses of the NMR images.

Detailed Description Text (79):
7. Spatial Resolution Required for NMR Sensors

Detailed Description Text (80):
The minimum spatial resolution for an NMR sensor can be estimated from the calculated error in the enthalpy per volume defined by the resolution distance times the cross-sectional area. The resolution distance determines how much volume of ice may be formed without being detected by the sensor, and thus defines the error in determining product enthalpy. The assumptions and definitions are as follows:

Detailed Description Text (95):
8. Temporal Resolution Required for NMR Sensors

Detailed Description Text (101):
The length of the magnetic field is given by ##EQU14## Only a small section of the magnet needs to have good homogeneity, that is, the region used for the NMRI measurement. For a small sample, about one-third of the field (8 cm) would be occupied by sample and require high homogeneity. Two-thirds (14 cm) could be a low homogeneity field. For larger samples, such as an 8 cm ear of corn, the length would be

Detailed Description Text (103):
In practice, three field gradients are required with linearity of 5% over twice the sample size. A low field strength permanent magnet should be adequate.

Detailed Description Text (105):
Accordingly, it will be seen that this invention provides an apparatus and method for accurate in-line, non-invasive determination of enthalpy of a food product through the use of NMR or NMRI to determine the ice content. As freezing is an energy intensive process, it is important to move the food through the freezer at the fastest rate possible. Once the desired enthalpy change has been achieved, further time in the freezer wastes energy and limits throughput. Conversely, it is crucial that the product remain in the freezer as long as necessary. While frozen storage rooms are designed to prevent further heat gain or loss, they may not have the capacity to remove additional heat from a product that arrives underfrozen; if it does, this heat may not be removed in the most energy efficient manner. In addition, freezing in such a room is likely to be slower and result in lower product quality.

Detailed Description Text (106):
By locating the ice interface in a product using magnetic resonance imaging in accordance with the present invention, it can easily be determined when the desired enthalpy change has been achieved. The liquid state will be seen as areas of high signal intensity, whereas the frozen state will be seen as areas of low signal intensity. Therefore, the ice interface will be seen as the region where the NMRI signal changes most rapidly. Enthalpy changes can then be determined from this information based on conventional computer modeling of food freezing. For a given food product, the computer model is used to predict the spatial location of the ice interface in the product under specified freezing conditions (e.g., temperature) for various levels of enthalpy. The predicted location of the ice interface is then compared to the actual location derived from the NMRI signals. Using a differential calorimeter to measure the true enthalpy corresponding to the position of the ice interface seen from the NMRI signals, the computer model is then calibrated to match the actual position of the ice interface for that enthalpy. Thereafter, the position of the ice interface determined from the NMRI signals can be correlated to enthalpy using the computer model. Alternatively, instead of using a computer model to correlate the position of the ice interface as seen from the NMRI images with enthalpy, the product is imaged to determine the total liquid portion and the total solid portion. The ratio of liquid to solid portions is then compared to calorimetry data for that product and a calibration curve is developed from the test data. Using that calibration curve, enthalpy can be determined as a function of the percent of total product which is frozen as seen from the NMRI signals. Further, for objects of

regular, or symmetrical geometric shape, the ratio of liquid to solid portions can be determined without using NMRI signals and, instead, integrating the amplitude of NMR signals (e.g., signals without using the gradient coils to determine spatial information). With any of the methods, once the calibration has been effected, enthalpy is determined automatically by control processor 26 based on the acquired NMRI or NMR signals.

Detailed Description Text (107):
It will be appreciated that the method of the present invention may vary as to the steps and their sequence and that the apparatus of the present invention may vary as to configuration and as to details of the parts without departing from the basic concepts as disclosed herein. Although the description above contains many specificities, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention. Thus the scope of this invention should be determined by the appended claims and their legal equivalents.

Detailed Description Paragraph Table (1):
TABLE 1 ______________________________________ Foods Studied by Nuclear Magnetic Resonance Imaging Type of Sample Freezer Geometry/mode Comments ______________________________________ Carrot Cryogenic Cylinder/3-D Cantelope Cryogenic Cylinder/3-D Potato Cryogenic Cylinder/3-D Yellow Squash Cryogenic Cylinder/3-D Onion Cryogenic Cylinder/3-D Beef Hot Dogs Cryogenic Cylinder/3-D As is Orange Juice Cryogenic Cylinder/3-D In plastic tubes Vanilla Ice Cryogenic Cylinder/3-D In plastic tubes Cream Carrot Air blast Cylinder/3-D Ends chopped Potato Air blast Cylinder/3-D Broccoli Air blast Irregular/3-D Ends Corn Cobs Air blast Irregular/3-D As is Chicken Legs Air blast Irregular/3-D As is Peas Air blast Cylinder/3-D In plastic tubes Beef Round- Air blast Slabs/1-D steak Beef Round- Air blast Slabs/3-D steak Ground Beef Air Blast Slabs/1-D Potato Air blast Irregular/3-D As is with skin ______________________________________

Other Reference Publication (1):
McCarthy et al., "Phase Volume Measurements Using Magnetic Resonance Imaging", Water Relationships in Foods, Edited by Levine and Slade, pp. 615-626, 1991.

Other Reference Publication (2):
McCarthy et al., "Magnetic Resonance Imaging Applications in Food Research", Trends in Food Science and Technology, Elsevier Science Publishers, pp. 134-139, 1990.

CLAIMS:

1. A nuclear magnetic resonance freezing sensor, comprising:

(a) means for subjecting an object containing fluid to nuclear magnetic resonance imaging and acquiring images of said object;

(b) means for identifying the ice content in said object while said fluid freezes from said images; and

(c) means for determining a change in enthalpy of said object from the ice content.

2. An apparatus for monitoring freezing of foods, comprising:

(a) means for subjecting an object containing water to nuclear magnetic resonance imaging and acquiring images of said object;

(b) means for identifying the position of the ice interface in said object from said images as sufficient heat is removed from said object for said water to freeze; and

(c) means for determining a change in enthalpy of said object from the position of the ice interface.

3. An apparatus for measuring changes in enthalpy during controlled freezing of food, comprising:

(a) means for subjecting an object containing fluid to nuclear magnetic resonance imaging and acquiring images of said object;

(b) means for determining the position of a transition for high to low signal

intensity in said images as said fluid freezes; and

(c) means for determining a change in enthalpy of said object from said intensity transition.

4. An apparatus for sensing the changes in enthalpy during transition from a liquid to solid state during controlling freezing of food, comprising:

(a) means for subjecting an object containing fluid to nuclear magnetic resonance imaging;

(b) means for acquiring images of liquid portions of said object from said nuclear magnetic resonance imaging;

(c) means for acquiring images of solid portions of said object from said nuclear magnetic resonance imaging;

(d) means for determining the liquid/solid ratio of said object from said images;

(e) means for determining a change in enthalpy of said object from said liquid/solid ratio.

5. An apparatus for sensing the changes in enthalpy during transition from a liquid to solid state during controlling freezing of food, comprising:

(a) means for subjecting an object containing fluid to nuclear magnetic resonance signals;

(b) means for determining the liquid/solid ratio of said object from said signals during freezing of said object; and

(c) means for determining a change in enthalpy of said object from said liquid/solid ratio.

6. A method of sensing freezing of an object, comprising:

(a) subjecting an object containing fluid to nuclear magnetic resonance imaging and acquiring images of said object;

(b) identifying the ice content in said object from said images while said fluid freezes; and

(c) determining a change in enthalpy of said object from the ice content.

7. A method of sensing freezing of foods, comprising:

(a) subjecting an object containing water to nuclear magnetic resonance imaging and acquiring images of said object;

(b) identifying the position of the ice interface in said object from said images as sufficient heat is removed from said object for said water to freeze; and

(c) determining a change in enthalpy of said object from the position of the ice interface.

8. A method of measuring changes in enthalpy during controlled freezing of food, comprising:

(a) subjecting an object containing fluid to nuclear magnetic resonance imaging and acquiring images of said object;

(b) determining the position of a transition for high to low signal intensity in said images as said fluid freezes; and

(c) determining a change in enthalpy of said object from said intensity transition.

9. A method of sensing the changes in enthalpy during transition from a liquid to solid state during controlling freezing of food, comprising:

(a) subjecting an object containing fluid to nuclear magnetic resonance imaging;

(b) acquiring images of liquid portions of said object from said nuclear magnetic resonance imaging;

(c) acquiring images of solid portions of said object from said nuclear magnetic resonance imaging;

(d) determining the liquid/solid ratio of said object from said images during freezing of said object;

(e) determining a change in enthalpy of said object from said liquid/solid ratio.

10. A method of sensing the changes in enthalpy during transition from a liquid to solid state during controlling freezing of food, comprising:

(a) subjecting an object containing fluid to nuclear magnetic resonance signals;

(b) determining the liquid/solid ratio of said object from said signals during freezing of said object; and

(c) determining a change in enthalpy of said object from said liquid/solid ratio.